

# International Marine Engineering

JUNE, 1911.

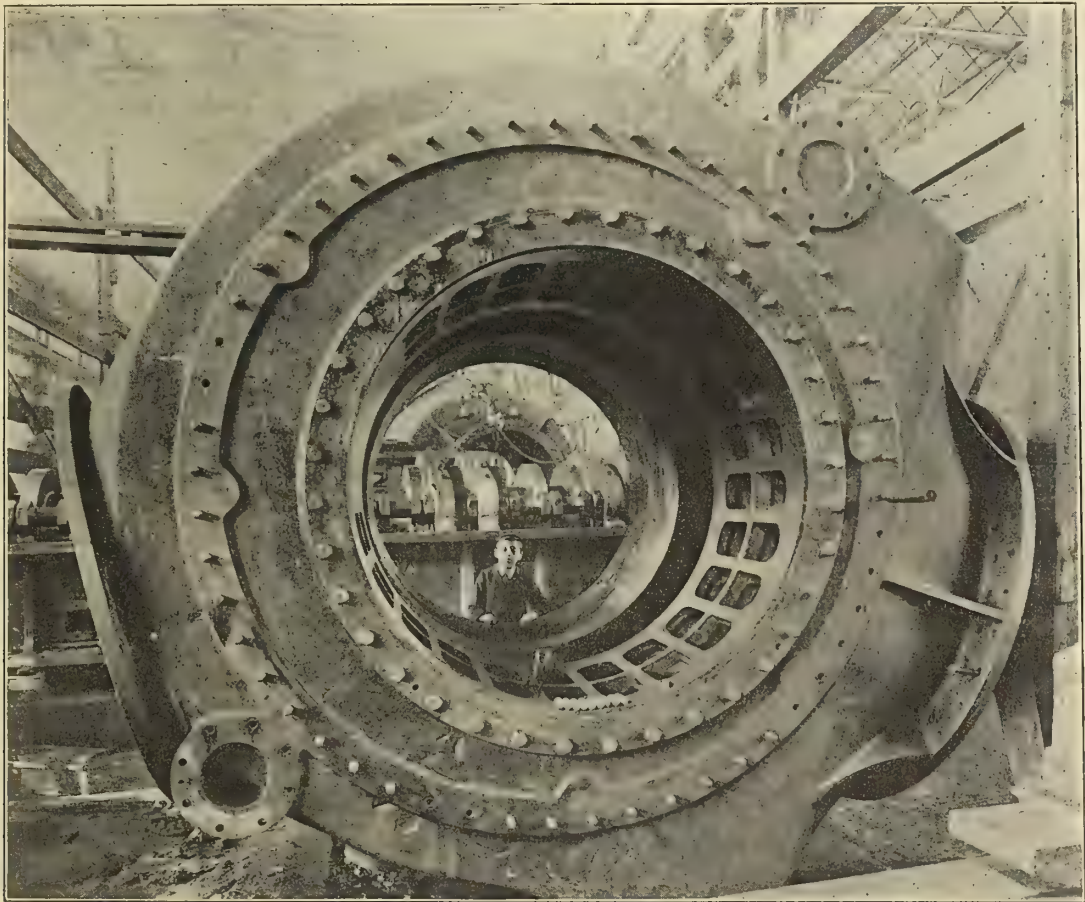
## THE WHITE STAR STEAMSHIP OLYMPIC.\*

NOTES ON HER MACHINERY.—The White Star liner *Olympic* was drydocked on Saturday, the 1st of April, at Belfast. She was the first vessel to be berthed in the large new dock constructed by the Belfast harbor commissioners.

The *Olympic* had been moored at the adjoining deep-water wharf, and two powerful tugs took her towards the entrance; material assistance in the operation was given by two 30-ton capstans. The difficult task of warping her in was accomplished by the 11-ton capstans placed near the head of the dock. At 10.50 the bow of the vessel crossed the entrance line

*Titanic*. Meanwhile, we are now able, by the courtesy of the builders, to present fuller details of the machinery of the *Olympic* than were available at the time of the launch.

The reciprocating engines in the *Olympic*—two sets, one driving each wing-shaft, as described in our December number—are of the four-cylinder, triple-compound type. They are arranged to work at 215 pounds per square inch and to exhaust at a pressure of about 9 pounds absolute. These engines are of the four-crank type, balanced on the Yarrow, Schlick and Tweedy system. The high-pressure cylinder is



CASING OF THE OLYMPIC'S CHANGE VALVE.

and 11.39 (eight minutes before high water) the stern passed the same place. She is 92 feet 6 inches wide and the dock entrance 96 feet, so that the margin in width was very slight. At 12.25 the caisson gate was placed and half an hour later the dock was partly emptied, so as to allow the liner to rest on the keel blocks and permit the shores to be placed in position. At 2.30 the whole vessel could be seen.

She is expected to go on trials about May 28 and be handed over to the White Star on the 31st of that month. The same day is fixed for the launching of her sister ship, the

54 inches in diameter, intermediate cylinder 84 inches, and each of the two low-pressure cylinders 97 inches in diameter, the stroke being 75 inches. Two slide valves, each with two ports in a common chest, are worked by two rods, through crosshead to single links, low-pressure cylinder, high-pressure cylinder, a single piston valve, two piston valves similarly arranged to the twin slide valves, intermediate-pressure cylinder, low-pressure cylinder, and, finally, at the aft end, two slide valves. The valves, as already noted, are operated by the Stephenson link motion. There is a loose coupling on the tail shaft, so that it can be withdrawn from the stern to faci-

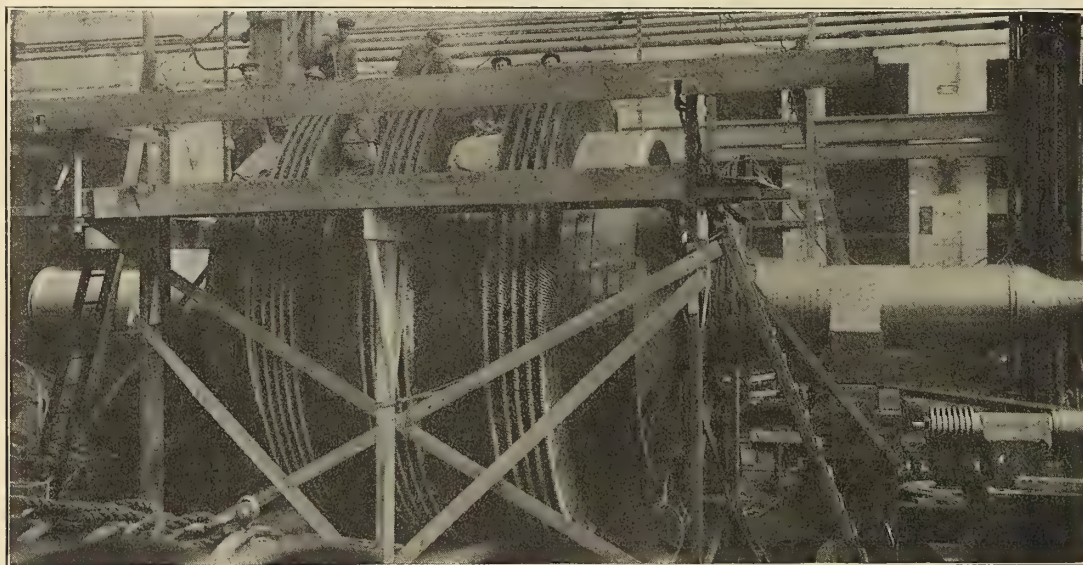
\* See issue of December, 1910, for further description of the *Olympic*.

tate repair. The propellers driven by the reciprocating engines have each a cast steel boss and three bronze blades, the diameter being 23 feet 6 inches, and when developing 15,000 indicated horsepower for each engine the revolutions will be 75 per minute.

The exhaust-steam turbine, by which the central screw is driven, is of the Parsons type, taking exhaust steam at about 9 pounds absolute, and expanding down to 1 pound absolute. The condensing plant is designed to attain a vacuum of 28½ inches (with barometer at 30 inches), the temperature of circulating water being 55 degrees to 60 degrees F. The rotor is built up of steel forgings. It is 12 feet in diameter, and the blades range in length from 18 inches to 25½ inches, on the segmental principle, laced on wire through the blades and distance pieces, at the roots, and with binding soldered on the edge, as usual. The length of the rotor between the extreme edges of the first and last ring of blades is 13 feet 8 inches.

hold level. These bunkers are arranged on each side of the main bulkheads, and immediately in front of the furnaces. Each stoker takes his coal from the bunker door. In each of the five boiler rooms there are two See's ash ejectors and four Railton and Campbell's ash hoists. A large duplex pump is in a separate compartment in each boiler room. This pump works the ash ejectors, circulates or feeds the boilers, and can be used for pumping the bilges, but in three of the boiler rooms there are independent ballast pumps. The pumps are directly connected to the bilge, as well as to the general bilge system. The air is supplied to the stokeholds by "Sirocco" fans—two for each boiler room. The exhaust turbine, instead of being in the same engine room with two sets of piston engines is in a separate compartment abaft the main reciprocating engine room, and divided from it by a watertight bulkhead.

In the reciprocating engine room there are two sets—one



TURBINE ROTOR AND SHAFT.

The rotor has a weight of 130 tons, and the turbine complete weighs 410 tons.

There are twenty-nine boilers in the ship with 159 furnaces. All boilers are 15 feet 9 inches in diameter. Twenty-four are double ended, 20 feet long; five are single ended, 11 feet 9 inches long. At each end there are three furnaces, all of the Morison type, with an inside diameter of 3 feet 9 inches. The working pressure is 215 pounds. The boilers are in six watertight compartments, five boilers athwartship. The boiler compartment nearest the machinery space accommodates the single-ended boilers, so arranged as to be available for running the auxiliary machinery. Two boilers in each of two other compartments have separate steam leads to the auxiliary machinery, which includes the electric lighting installation. The electric output is 1,600 kilowatts. The other five rooms are fitted with the double-ended boilers. The uptake connections are widely spread. The uptakes for two centre boiler-rooms exhaust into the second funnel from the forward end; and the two after boiler rooms exhaust into the third funnel. The fourth funnel is intended for ventilating purposes, and it also has the galleys chimney. All the funnels are elliptical in plan, the dimensions being 24 feet 6 inches by 19 feet, and the average height above the level of the furnace bars is 160 feet.

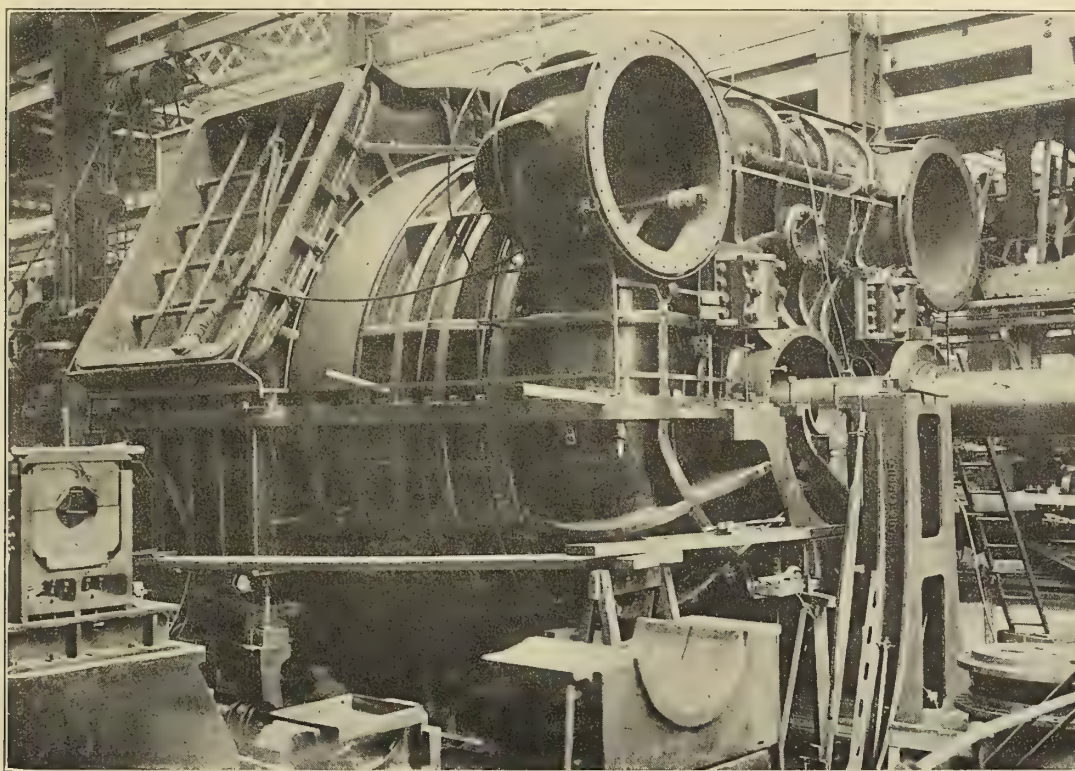
There is a main bunker 'tween decks, immediately within the skin of the ship, and into this the coal is first shipped and then distributed into bunkers athwart the ship and at stoke-

holding the port and the other the starboard shaft; in the wings there are the main feed and hot well, bilge, sanitary, ballast, and fresh-water pumps, and a contact and surface heater; while on the port side is the extensive refrigerating plant. In the exhaust-turbine room there is, immediately forward of the turbine, the manoeuvring or change valves, which control the flow of steam either to the turbine or to the condenser—the latter for manoeuvring. This control is exercised from the main starting platform through a Brown's hydraulic engine, placed between the two change valves on the bulkhead. There is a steam strainer, through which the steam passes on its way from the piston engines to the turbine in each wing. There are two oil coolers and a pump for circulating the oil in them. Aft the exhaust-turbine room, and on each side of the shaft driven by the turbine, and within the wing shafts, there are four sets of electric light engines, each of 400 kilowatts capacity. There are also on a gallery above the load water line in the exhaust-turbine room two electric generating sets of 35 kilowatts capacity. Steam pipes are led from three of the boiler rooms to these emergency electric generators independently and above the watertight bulkheads, and from this steam supply also it is possible to work any of the pumps connected to the bilge throughout the ship. Between the boilers and the main steam stop-valve there is a steam separator. There are two main steam leads from the boiler room, each terminating at the stop-valve and separator, which are situated against the forward engine room bulkhead.

The exhaust pipes from the low-pressure cylinders connecting with the change valve are fitted with bellows joints, which consist of two flattened conical discs with special steel rings and with flanges to take the pipes. All the pipes in proximity to the condenser are fitted with these bellows joints.

The change valves for shutting off steam to the turbine and opening it to the condenser direct, for manœuvring purposes, are of the piston type with a ring of special form. When the pistons of these valves are in their highest position, steam has a clear flow to the strainer and thence to the turbine; when the piston is lowered the connection to the strainer is closed and that to the condenser is opened. The reduction pipe from the turbine to the condenser is fitted with a large sluice valve (the closing slides in two pieces, worked together through worm-and-rack gear) actuated by an electric motor. Four sets of gun-metal circulating pumps, two for the port and two for the starboard condensers, with 29-inch inlet pipes, are driven by compound engines. For each condenser there

trolled from the navigating bridge by telemotors and from the docking bridge, aft, by mechanical means. The electric lighting engines, which indicate each about 580 horsepower, are of the Allan vertical three-crank compound, enclosed forced-lubrication type, running at 325 revolutions per minute. Each set has one high-pressure cylinder, 17 inches in diameter, and two low-pressure cylinders, each 20 inches in diameter, with a 13-inch stroke. They take steam at 185-pound pressure per square inch. Each engine is direct-coupled to a compound-wound dynamo, with an output of 100 volts and 4,000 amperes, continuous current, so that their collective current capacity is 16,000 amperes. The dynamos are of the ten-pole type and are fitted with inter-poles. In addition to the four main generating sets there are two 30-kilowatt engines and dynamos, placed in a recess off the turbine room at the saloon deck level, well above the water line. Three sets will be supplied with steam from either of several boiler rooms and will be available for emergency purposes.



ONE OF THE TURBINE CASINGS.

are two sets of Weir's air pumps, of the "Dual" type, both air and water barrels being 36 inches in diameter by 21-inch stroke. The water from each condenser passes into a feed tank; thence it drains into a control tank, from which the hot-well pumps draw it, discharging it through the Weir's surface heater to a Weir's contact heater, on the engine room bulkhead. The surface heater takes the exhaust from the electric engines for heating the feed, while the contact heater utilizes the exhaust from the other auxiliaries for the same purpose. The water from the contact heater gravitates to the main feed pumps.

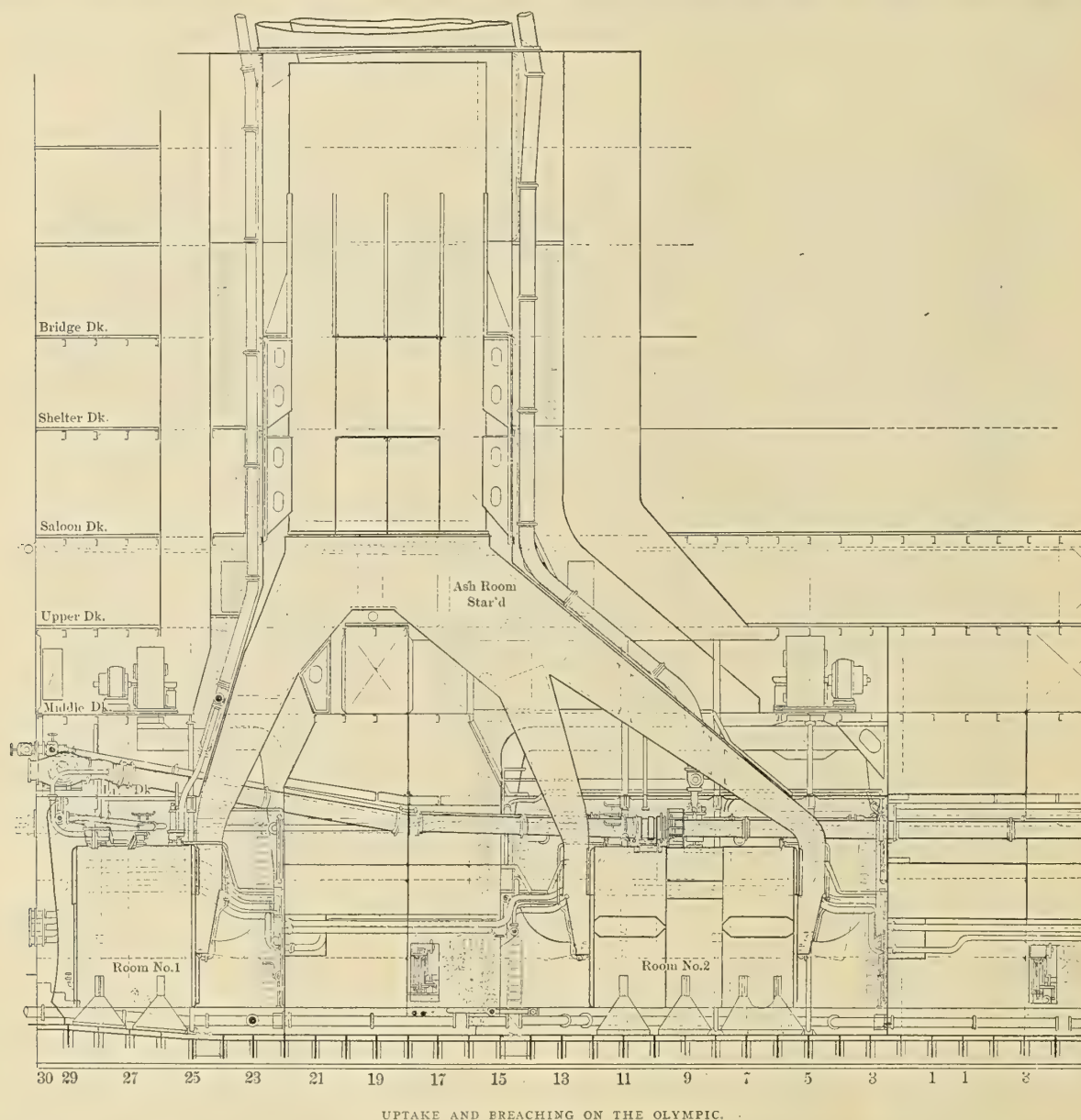
The steering gear is fitted on the shelter deck. The diameter of the rudder stock is 23½ inches. The gear is of Harland & Wolff's wheel-and-pinion type, working through a spring quadrant on the rudder head, with two independent engines having triple cylinders, one on each side. The quadrant is designed to minimize the shocks received in a sea-way. The spur-and-bevel gear is of cast steel. The gear is con-

#### Australian Liner "Aeneas."

To carry on the new service which the Ocean Steamship Company is inaugurating between Great Britain and Australia a number of large and splendidly equipped passenger and freight steamships are being built in Belfast and elsewhere. The first of these, the *Aeneas*, of 19,500 tons displacement, was launched August 23, 1910. She is a twin-screw vessel, 509 feet long over all, 60 feet molded breadth and 40 feet molded depth. She has five decks: the promenade, center castle, upper, main and lower decks, providing accommodation for about three hundred passengers in commodious and airy, two, three and four-berth cabins. The cabins on the center castle deck are lighted and ventilated from the ship's side, being arranged on what is known as the "tandem system." All of the public rooms throughout the vessel are large and airy, and have been specially fitted up with a view to providing the greatest comfort for the passengers. The dining saloon is

on the second deck. It is tastefully decorated with oak dado and panels in French grey. There is a central lighting well in the room, which rises through two decks and is surmounted by a handsome stained glass skylight. The panels of the well being decorated with the coats-of-arms of the various provinces of the Australian Commonwealth. A series of handsome oak staircases lead from the dining room to the main entrance hall on the center castle deck, which is decorated in oak dado with upper panels in white enamel. Aft of the entrance hall is the music room, exquisitely decorated in oak with French grey panels tastefully relieved by ornaments in the Adams style. On the same deck, but further aft, is the smoking room, the decorations of which are in the Early English style, carried out

As much of the cargo which is carried in the Australian trade is frozen meat, dairy produce and fruit, one entire hold and the after between deck have been thoroughly insulated and fitted up for the carriage of this class of cargo. The refrigerating plant is on the CO<sub>2</sub> system, the cooling effect being transmitted to the holds by means of brine circulating pipes arranged in coils. Another innovation, which has only recently come into general use on large steamships operating on long voyages, is an up-to-date steam laundry. The cargo space of the vessel is divided by watertight bulkheads into six main holds, which, on account of the girder system of construction, are practically free from obstruction, and thus capable of receiving large and bulky freight, such as motor



UPTAKE AND BREACHING ON THE OLYMPIC.

in oak embellished with a series of artistically carved frieze panels illustrating scenes in the hunting field. The vessel is lighted throughout by electricity, and efficient ventilation is provided throughout the living quarters by means of electrically driven fans installed in all the public rooms. An adequate steam heating system, for use in Northern latitudes, is installed, as well as the most modern appliances for insuring the safety of the ship, such as wireless telegraph, submarine signaling apparatus, modern lifeboats and launching apparatus.

cars, boilers, locomotives and machinery of all kinds. The hatches to these holds have been constructed of large size to meet the requirements of such cargo, and each hatch is served by two or three steam winches, the largest of which are capable of dealing with weights up to 40 tons.

The propelling machinery consists of two sets of triple expansion engines, constructed by Messrs. Workman, Clark & Company, Ltd. Steam is supplied by three double-ended Scotch boilers, working under an improved system of forced draft. The stokeholds are provided with both ash ejectors and

steam ash hoists. The engine room is large and is well lighted and ventilated to insure as efficient service as possible in tropical waters. There is the usual equipment of auxiliary machinery.

### Twin-Screw Floating Crane.

The crane which we illustrate was built by the firm of A. F. Smulders, Schiedam, Holland, for the Argentine Government. The crane is for the harbor of Buenos Aires. There were two of these cranes, the main dimensions of which are as follows:

|                                          | 100-Ton,<br>Ft. Ins. | 60-Ton,<br>Ft. Ins. |
|------------------------------------------|----------------------|---------------------|
| Length between perpendiculars.....       | 154 2½               | 131 2½              |
| Breadth between perpendiculars.....      | 55 9 5/16            | 55 9 5/16           |
| Depth amidships measured at the side.... | 13 1½                | 11 9¾               |
| Clear lift .....                         | 78 9                 | 78 9                |
| Clear overhang .....                     | 27 2¾                | 27 2¾               |
| Swinging radius .....                    | 27 2¾                | 27 2¾               |

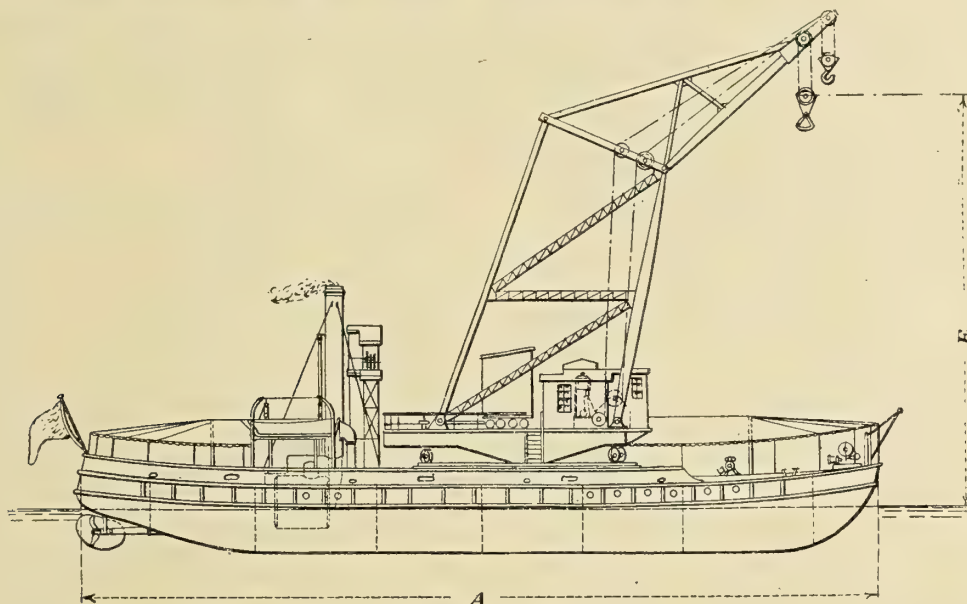
The 60-ton crane is of the same construction as the 100-ton crane, with the sole difference that instead of a five-sheave block it has one with three sheaves, and that the jib is of a

for the lifting of 100 tons, which is done by means of a five-sheave block, and one set for the lifting of 20 tons by means of a two-sheave block, both with two hoisting cables. The lowering of the weights is done by automatically-worked brakes and noiseless ratchets. The crane can be turned at will to the right or left by a set of conical friction wheels. The engines of the 60-ton crane developed together 601 indicated horsepower, giving the vessel a speed of 16 kilometres (9.9 statute miles) an hour, whereas the contract prescribed 12 kilometres (7.4 statute miles) only in the case of both cranes.

### Jubilee Meetings of the Institution of Naval Architects.

A preliminary programme of the International Congress in Naval Architecture and Marine Engineering, to be held in connection with the jubilee meetings of the Institution of Naval Architects, London, to celebrate the fiftieth anniversary of its foundation, has been announced. It is as follows:

Monday, July 3.—Evening: Reception at the Royal United Service Institution.



TWIN-SCREW FLOATING CRANE.

somewhat lighter construction. The steam anchor-winch, two steam-winch, with the necessary sheaves, are on deck for the purpose of working the vessels. Besides the space for boilers, engines and coal, the vessels are fitted with cabins for the chief engineer, captain, first and second engineers, with messroom, crew space for thirty men, galley, etc. Each ship has two boilers, each of 1,076 square feet surface, and working at a pressure of 120 pounds, which provide the steam for two compound engines with surface condensation, each working on a propeller. The diameter of the high-pressure cylinder is 15 inches and that of the low-pressure cylinder 30 inches, the piston stroke being 20 inches. During the official trial the engines of the 100-ton crane developed together about 550 indicated horsepower, and gave the vessel a speed of nearly 15 kilometers (9.3 statute miles) per hour.

The crane-winch is driven by a vertical compound engine, having cylinders 12 inches in diameter and 23½ inches, and a stroke of 14 inches. The exhaust steam is delivered to a surface condenser in the engine room. Both the live steam and the exhaust steam are conducted through the center of the crane platform by means of a cast copper conduit, provided with the necessary glands to allow of the turning of the platform. The winch drives two sets of drums, one set

Tuesday, July 4.—Morning, 11.30 A. M.: Opening of the International Congress by His Royal Highness the Duke of Connaught, K. G., in the Connaught Rooms, Great Queen street, near Kingsway. Afternoon: Official visit to the Coronation Exhibition, Shepherd's Bush. Evening: Reception given by the Right Hon. Lord Brassey, G. C. B., past president of the Institution.

Wednesday, Thursday and Friday, July 5, 6 and 7.—Mornings, 11 A. M. to 1 P. M.: Reading and discussion of papers in the halls of the Institution of Civil Engineers and the Institution of Mechanical Engineers. The programme will include papers contributed by leading English, American, Italian, Japanese, German, French and Swedish engineers.

Wednesday, July 5.—Afternoon: Visit to the Empire Festival, to witness the Pageant of London, in the grounds of the Crystal Palace. Evening: Grand festival concert in the Queen's Hall.

Thursday, July 6.—Afternoon: Visit to the National Physical Laboratory to inspect the national experimental tank. Evening: Banquet to the delegates and representatives, at the Connaught Rooms, Great Queen street, near Kingsway.

Friday, July 7.—Afternoon: River trip down the Thames, to visit the docks and shipping of the port of London.

### THE COMING BIG CUNARD.

We live in the age of big ships, and no one can say that the limit is even yet within sight. The competition among the Atlantic shipping lines to possess the largest and the fastest vessel afloat continues. It is barely six months since Messrs. Harland & Wolff launched for the White Star Line the *Olympic* as "the largest vessel in the world." And so she was, but there was no assurance that even a vessel of 882 feet 6 inches length over all would spell finality in the arts of the shipbuilder.

Ere she was three months in the water preparations were made to lay down in a British yard a vessel exceeding the dimensions of the *Olympic*. Since the launch of the *Lusitania* and *Mauretania* persistent reports have been in circulation associating the Cunard Company with a design of larger size than either of these vessels. That design is now taking form in the yards of Messrs. John Brown & Co., Clydebank, Glasgow. It is, of course, not possible to obtain positive details of a vessel of which the keel plates are hardly laid, for the specifications are still subject to revisal, but there is no doubt that the new Cunarder will exceed by about 120 feet the length of the *Mauretania* and *Lusitania*. The Cunard Company, as a matter of fact, has planned a vessel 850 feet in length between perpendiculars and 885 feet over all. The Government in this case, as it did in the *Lusitania* and *Mauretania*, has no part. Messrs. John Brown & Co., Clydebank, the builders of the *Lusitania*, and of a fleet of Cunarders before her, are the experts entrusted with the new work, which will approximately cost £2,000,000 (\$10,000,000).

The interim specifications are for a vessel of 885 feet over all, comparing with 882 feet 6 inches in the *Olympic*. The *Olympic* is 92 feet broad, but the Cunard Liner will have a breadth of at least 95 feet 6 inches. The length of the *Mauretania* is 762 feet and the breadth 88 feet. The new liner is not to emulate either the *Mauretania* or the *Lusitania* in speed, but will surpass the *Olympic*, which, of course, makes no claims to being a fast ship. The speed of the *Olympic* is 21 knots, but the new Cunard vessel will be constructed for an average speed of 23 knots on a draught of 34 feet. The contract speed of 25 knots by the *Mauretania* and the *Lusitania* has been frequently exceeded by both these vessels. The new Cunard Liner will have turbines operating quadruple screws. She will have four funnels and two pole masts. Her coal capacity will be 6,500 tons, and her total displacement 50,000 tons. That is to say, she will displace 5,000 tons more than the *Olympic*. Her double bottom will be arranged to carry oil fuel if found advisable. There will, of course, be an installation of wireless telegraphy. There will be Turkish and electric baths at the disposal of the passengers, a printing establishment for the issue of a daily paper, and a swimming pond will vary from 50 inches to 15 inches. There will also be a theatre stage in the first-class lounge. The accommodation to be provided is: For first class passengers, 650; second class, 740; third class, 2,400, a total of 3,790, which compares with 2,500 in the *Olympic* and 2,200 in the *Mauretania* and the *Lusitania*.

The possibility of a breakdown of machinery on such a large steamer has been well considered, and means are devised to ensure that in the event of such an accident taking place no disablement will result. A general rule with the Admiralty is for a double skin round the hull at the part enclosing the machinery. If a collision occurs and plates are fractured or should the vessel ground and damage plates the inrush of water finds its way between the skins and does not come in contact with the machinery at all. An alternative plan is to construct the main bulkhead in the engine room in two distinct watertight compartments. The new Cunarder

will, we understand, have a double skin to the load line. Ship-owners usually content themselves with indicating the dimensions and special features they desire and leave the details to the shipbuilder. The Cunard Company knew what it wanted before issuing the specifications as to the general arrangements. The desire in detail for the comfort of the passengers was that while the new liner will not outstrip the *Mauretania* and *Lusitania* in speed, she will surpass them in luxurious equipment, in fittings, and in the general arrangements for the comfort of passengers. The passenger accommodation may possibly be increased to bring it up to 4,000, so that with her crew and a full complement the number on board will be about 5,000. She will then have accommodation for 1,800 passengers more than the *Mauretania* or *Lusitania* and for 1,500 more than the *Olympic*. There will be suites of rooms, many single berths, and family suites, a passenger lift, complete telephone system throughout the ship, a system of electric bells, etc., as well as what has been named above.

The figures named above were in the specification, but before placing the contract with Messrs. John Brown & Co. the ultimate dimensions of the vessel were left open. The company desires not a record-breaking vessel nor cares whether she exceeds in size the new Hamburg-American liner *Europa*, so long as she meets its wishes and suits its business. Something has been added to the length originally specified, but the ultimate figures closely approximate what we have stated.

The Cunard Company has decided that the new steamer shall be named *Aquitania*, the practice of the company being to name after provinces of the Roman Empire on or near the Mediterranean. This name is derived from Aquitaine, a Roman province in France.

Preparations are now being made at Clydebank for laying the keel of the new vessel. She will occupy the berth upon which the *Lusitania* was constructed. The *Lusitania* was built at an angle of 40 degrees to the river, which angle will be exceeded, in view of the increase of 140 feet in length. Although many powerful vessels have been built at the Clydebank yard, it was decided before laying the keel of the *Lusitania* to specially prepare the berth on account of the intense forward pressure at the bow at the launch when the stern became water-borne. Piles were driven into the area subjected to this pressure, and bound on top with crossties in order to distribute the strain. Among present plans is one to lay a special berth of concrete. Messrs. Brown give £10,000 to the Clyde Trust to be used for river improvements for launching facilities at their yards. The river opposite is about 610 feet in width, but the launching area includes the confluence of the Clyde and Cart, into which the *Lusitania* was launched. It is capable of extension, and the scheme of the Clyde Trust provides for the widening and deepening of the river opposite Brown's establishment. About two years will elapse before the new Cunarder is completed for service, but she will be ready for launching next year.

### 35-Mile Steam Yacht Sovereign.

What is guaranteed to be the fastest steam yacht in the world was launched last month at the Morris Heights, New York City, yard of the Gas Engine & Power Company and Charles L. Seabury & Co. This new speed wonder was built for M. C. D. Borden, of New York and Fall River, and is to make 35 miles an hour. She was christened by Mrs. B. H. Borden.

Mr. Borden, who is one of the oldest members of the New York Yacht Club, has owned many handsome steam yachts

whose records for speed have made them conspicuous, but nothing to compare with the *Sovereign*. This yacht was built from the design of Charles L. Seabury, and is 165 feet

with bronze bushing, and the stern post is a steel plate, flanged and fitted to the counter. The frame is of galvanized steel, the floor of steel plates, the garboard strake and bilge

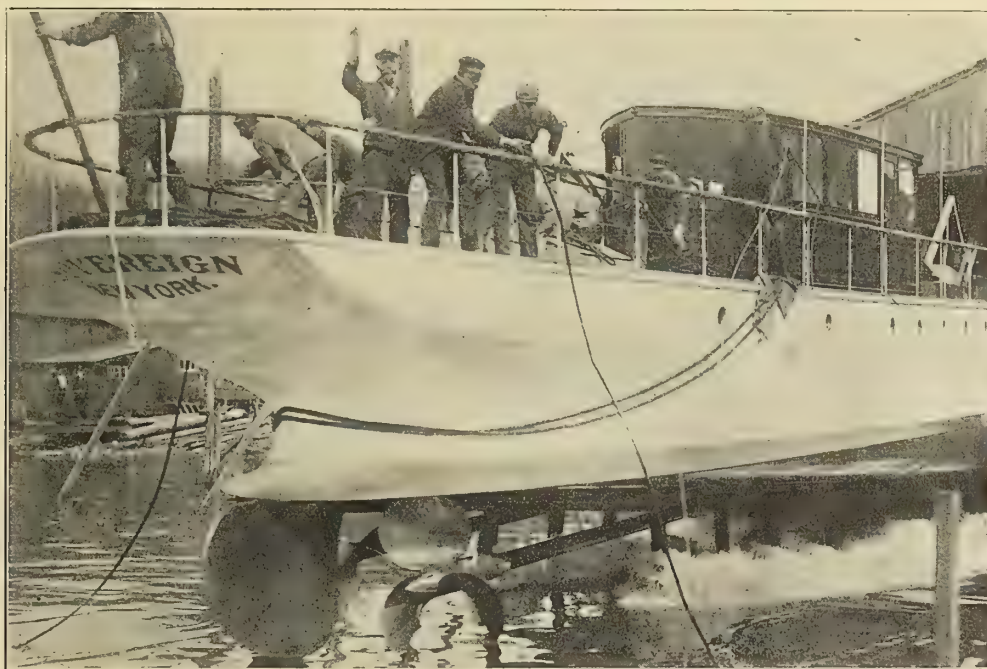


35-MILE STEAM YACHT SOVEREIGN.

over all, 158 feet at the waterline, 4 feet 6 inches draft, and has a beam of 16 feet. She has twin screw. Thirty-five miles an hour is guaranteed by the builders, and, so far as we recall, has never been attempted in a vessel of this type. The new yacht will have four smokestacks, giving her the dis-

plating of Tobin bronze. The sheer strake and side plating are of steel, as are the keelson, deck beam, bulkhead and engine foundation.

The machinery will consist of two triple-expansion engines, and steam will be generated by two water-tube boilers. The



LAUNCHING STEAM YACHT SOVEREIGN.

tinctiveness in this respect that no other pleasure craft in the United States possesses. In this and other ways her appearance will attract much attention.

The *Sovereign* has a bronze keel. The stern is of steel,

*Sovereign* will be fitted with steam steering gear and will be handled from the bridge at the after end of the forward deck-house. The yacht will be lighted throughout with electricity. She has excellent accommodations for her owner.

### The Steamer Sankaty.

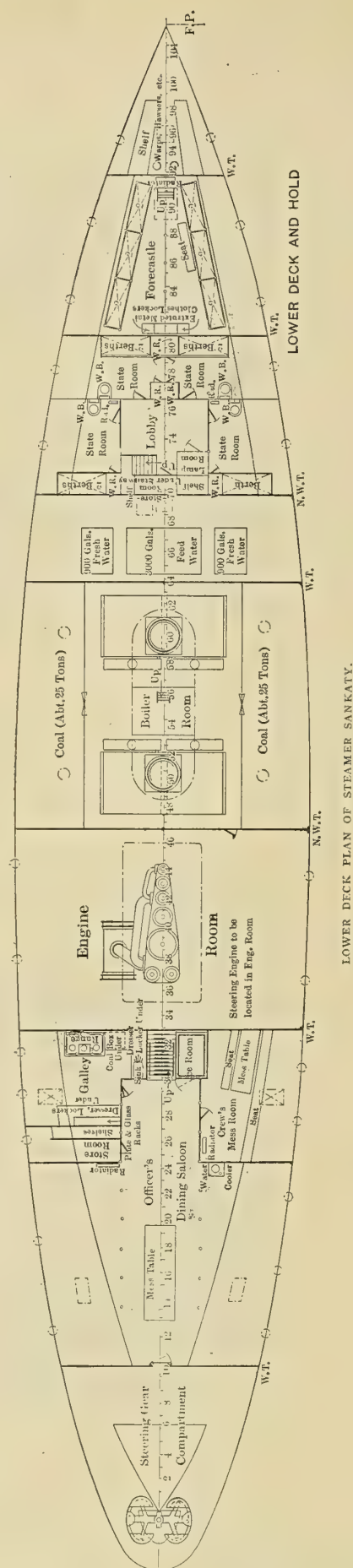
A new steamer has been added to the fleet of the New Bedford, Martha's Vineyard & Nantucket Steamboat Company in the *Sankaty*, built by the Fore River Shipbuilding Company. This vessel differs from the four others owned by this company, in being of the screw-propeller instead of the side-wheel type. Previous to the time of contracting for the *Sankaty* the shallow water at the Nantucket bar had made it impossible to design a propeller boat with sufficient carrying capacity at the permissible draft. With the deepening of the channel, however, this condition was removed. The *Sankaty* is designed under the classification of the American Bureau of Shipping both for freight and passengers, and it is expected that the winter work in carrying the Nantucket mails will fall largely to her, the other steamers not being of sufficient power and suitable design to combat the worst storms.

The *Sankaty* is of the sponson-deck type, the overhang forming an integral part of the structural hull. The main deck and joiner deck are complete all fore and aft, and the hurricane deck extends from the stern to the pilot house, providing stowage for the boats and an ample walking space for passengers. Below the main deck a lower deck extends forward and aft of the machinery spaces to the ends of the vessel. The vessel is divided fore and aft by transverse bulkheads into six watertight compartments, insuring an unusual amount of safety in event of damage to the hull. The general dimensions follow:

- Length over all ..... 195 feet.
- Length on waterline ..... 188 feet.
- Breadth extreme, outside of guard. 38 feet 2 inches.
- Breadth molded at waterline ..... 31 feet 6 inches.
- Depth molded ..... 12 feet 6 inches.
- Draft loaded extreme not to exceed. 9 feet 6 inches.

The interior arrangement provides commodious quarters for passengers and an ample freight space, as well as berthing for the crew. The fore part of the main deck is a clear freight space. At the bow are the windlass, etc. The house starts about 53 feet from the stem and has two sliding doors in the forward bulkhead of ample width for the passage of automobiles and large freight. Back of the bulkhead in the center a stairway leads up to the joiner deck. The boiler and engine house is amidships, with main stairway up to joiner deck aft of the engine enclosure and the stairway down to the dining-room. At the foot of main stairway is the entrance lobby and social hall, with purser's office on the starboard and chief engineer's stateroom on the port side. The joiner deck is given over entirely to the accommodation of passengers. Forward and aft of the house the deck is an open promenade with slatted wood seat arranged wherever possible. On the inside the house comprises a large and tastefully-decorated main saloon with a special parlor aft for ladies. For the convenience of people desiring privacy there are located on either side of the main saloon three well-appointed day rooms and a commodious stateroom.

The structure of the hull was especially designed for the rough winter service in which the vessel will be engaged, the parts being especially strengthened where necessary. The usual type of frame and reverse frame is used, the floors being carried straight across the top and fitted intercostally at the center line. In way of the sponsons the frames are carried continuously around the curve of the side to the fender channel. The reverse frames are carried straight up from the sides and are connected by a bracket to the frames and deck beams and by suitable riveting to a longitudinal strength girder running under the beams. Five channel web frames on each side with doubled deck beams furnish additional stiffness in way of the machinery spaces. The side keelsons and



stringer are of double angle, the first keelson having also an intercostal plate with angle clips to shell and floors. The foundations for the engine, boilers and auxiliaries are specially constructed on high floors and longitudinals or on built-up foundations. The flat plate keel is provided with an extra heavy steel rubbing piece to prevent injury in case of grounding on a bar, and an 18-inch I-beam with plate floor stringer and channel rider make up the vertical keel. The shell plating is arranged with "in-and-out" strakes carried continuously on the curve of the sponson and attached to the deck through a vertical channel, which also holds the fender. Above the main deck a steel bulwark runs all fore and aft.

The lower deck beams are of angle section or alternate frames with steel stringer and tie plates. Main deck beams are channels on alternate frames, except under forward deck, where there are angles on every frame. The deck is plated complete over machinery spaces, seven complete bulkheads

bine set of 15 kilowatt capacity, with switchboard complete. One hundred and fifty outlets are provided for, and independent circuits are run to the running lights and to the projector, a 13-inch General Electric commercial type with pilot-house control. The lighting arrangement in the principal passenger spaces gives a pleasing effect, being on a special system in use on other boats of this company. The lamps are attached to the cornice itself by a special fitting of neat design, the wiring being entirely concealed in the molding, which is grooved at the back for the purpose. The electric fittings throughout are in bronze finish.

The life-saving appliances are four 24-foot metallic life-boats, one 12-foot and one 8-foot metallic cylinder life-raft and 1,000 cork life preservers. In addition a wooden "pick-up" boat 16 feet long is installed. The boats are handled by the ordinary swivel-type davits. One 1,000-pound and one 900-pound Baldt stockless anchor are supplied, with a steel



STEAMER SANKATY GOING INTO COMMISSION.

are fitted below main deck, five being watertight. Longitudinal coal bunker bulkheads extend the length of the boiler space on either side. The decks are supported throughout by pipe stanchions and I-beam girders.

The steering gear is of the Hyde combined steam and hand type, 6 inches by 6 inches, and interchangeable only at the engine. It is located in the engine room, being connected to the quadrant by a  $\frac{3}{4}$ -inch wire rope, and is driven by wire rope and bevel gears from the pilot house. Aft on the main deck is located a Providence-type crank capstan. Four 36-inch cleats with mooring parts are arranged on each side, two forward and two aft. The windlass forward on the main deck is of the Providence hand pump brake type, and is fitted with wildcats to take both 1-inch and  $\frac{3}{4}$ -inch close link chain cable. The drainage system consists of galvanized iron bilge suction pipes drawing from each watertight compartment and leading through a manifold to the bilge pump in the engine room. The fire-main comprises a brass pipe running fore and aft under the main deck with risers terminating in hose gate valves on the main, joiner and hurricane decks. Two deck fire pumps are supplied.

The electric plant consists of a General Electric Curtis tur-

davit and tackle for handling. Also 30 fathoms of 1-inch and 30 fathoms of  $\frac{3}{4}$ -inch close link chain. The *Sankaty* is amply steam heated throughout the living spaces, and the exposed steel surfaces have been covered with cork paint, ensuring the maximum amount of comfort to passengers during the winter months.

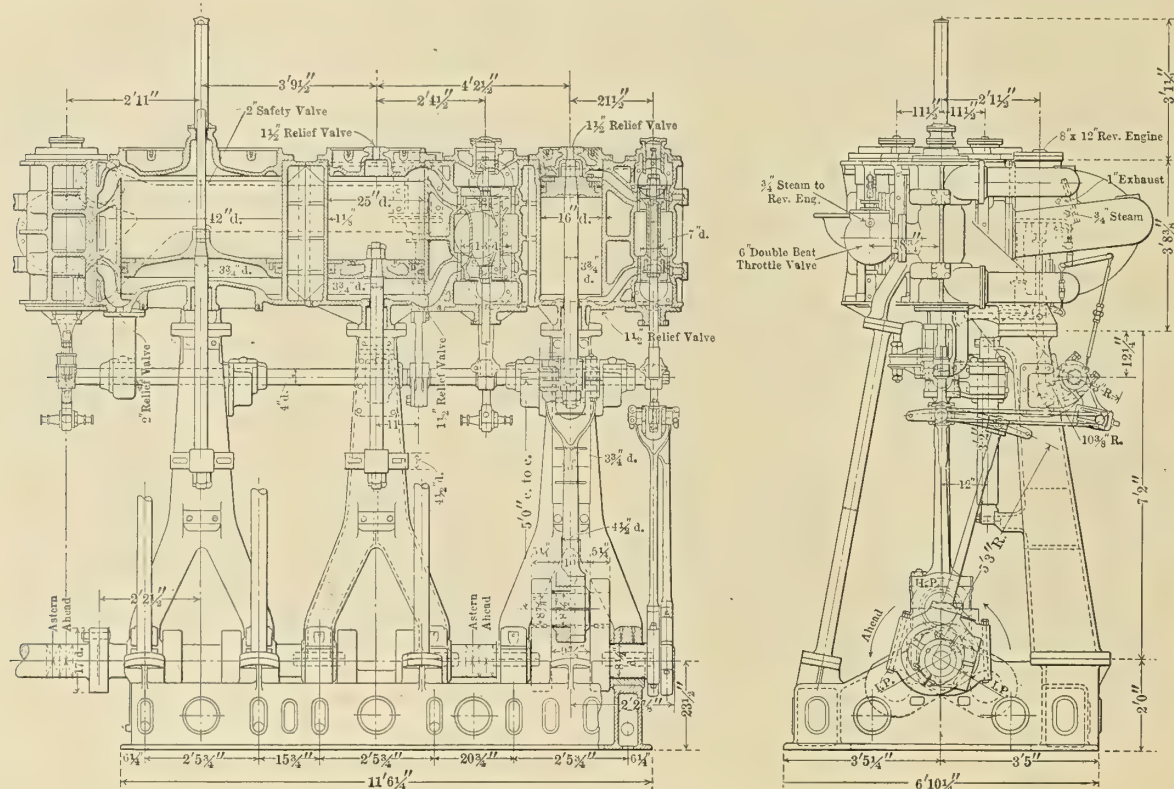
#### THE PROPELLING MACHINERY.

The propelling machinery, located amidships, consists of a vertical inverted, three-cylinder, triple-expansion engine, with cylinders 16, 25, 42 inches diameter, having a stroke of 27 inches. The bed-plate of the main engine is of the usual box section form in one piece, having six cross girders. The six main bearings,  $8\frac{1}{2}$  inches diameter and 9 inches long, with their caps, are cast iron lined with white metal. The cylinders are supported by seven columns, three cast iron at the back and four forged steel at the front. The box guides, bolted to the back columns, are hollow and fitted for water circulation. The crankshaft is forged steel throughout with webs shrunk to pins and journals. All webs are  $5\frac{1}{4}$  inches by 16 inches. Crankpins are  $8\frac{1}{2}$  inches diameter, 10 inches long. The cylinders are arranged, beginning at the forward end of the

engine, high-pressure, intermediate-pressure and low-pressure. All cylinders are fitted with piston valves. The high and intermediate-pressure cylinders each have one and the low pressure two valves of this type. The valve diameters are 7 inches for the high and 13 inches for the intermediate and low-pressure. All valves are fitted with balance cylinders for taking the weight of valves and gear. The high and intermediate-pressure pistons are flat cast iron, the low-pressure is cast steel of conical form. All pistons are fitted with cast iron followers and Christie packing rings. The piston rods are  $3\frac{3}{4}$  inches diameter, the low-pressure being fitted with a tail rod  $2\frac{3}{8}$  inches diameter. Piston rods and valve stems are packed with metallic packing. The crosshead shoes are cast iron fitted with composition gibs, faced with white metal. The crosshead pins are  $4\frac{1}{2}$  inches diameter and 5 inches long. The connecting rods are forged steel, 60 inches between centers, fitted with composition top end brasses and cast steel bottom brasses, lined with white metal. The valve gear is of the

thrust bearing is of the usual horseshoe type, having seven adjustable cast iron horseshoes faced with white metal. The stern tube bearings are of composition lined with strips of lignum vitae. The propeller is of the solid type, cast iron, 8 feet diameter, 10 feet 6 inches pitch, 29 square feet developed area.

The main air pump is of the Blake vertical single-acting beam type, with steam cylinders  $7\frac{1}{2}$  inches diameter, air cylinders  $16\frac{1}{2}$  inches diameter, all with a common stroke of 10 inches. The main condenser has a cylindrical steel plate shell, with cast iron water chests and cover. There are 1,344  $\frac{5}{8}$ -inch brass tubes 7 feet  $\frac{1}{4}$  inch between tube sheets, giving a cooling surface of 1,544 square feet. The tube ends are packed in the usual manner with cotton wicking, secured by brass glands, screwed into rolled composition tube sheets. Cooling water for the condenser is taken from a centrifugal pump furnished by the Morris Machine Company, having an 8-inch suction and 8-inch discharge. - The pump, direct connected to



ENGINE OF STEAMER SANKATY.

usual Stephenson double bar link type. A 6-inch double poppet throttle valve, worked by a hand lever, controls the supply of steam to the high-pressure chest. All receivers are copper pipes, installed with ample bends for expansion.

The reversing gear consists of a direct-acting steam cylinder, 8 inches diameter, 12 inches stroke, secured to the back of the intermediate-pressure cylinder. A forged steel reverse shaft, 4 inches diameter, carried in bearings at the back of the engine, transmits motion from the reversing engine to the links. The cut-off of each valve may be adjusted separately by means of a sliding block, working in slotted reverse shaft arms. A hand-turning gear is fitted at the after end of the bed-plate. The thrust shaft is  $8\frac{1}{2}$  inches diameter with seven collars 15 inches diameter,  $1\frac{3}{4}$  inches thick, forged solid with the shaft. The line shafting is  $8\frac{1}{4}$  inches diameter, and the propeller shaft is 9 inches diameter. The propeller is secured to the tapered end of the shaft by a composition nut and steel feather. All shaft couplings are 17 inches diameter,  $2\frac{1}{2}$  inches thick, connected by six forged steel taper bolts. The

a 6 by 6 vertical engine, has the following connections: 8-inch suction from sea and 6-inch bilge suction, with 8-inch discharge through main condenser. The following additional pumps are fitted: One main feed, 6 inches by 4 inches by 6 inches vertical duplex, with suction from the feed and filter tank and fresh-water tanks and discharge to the boilers, through a grease extractor and a Reilly feed-water heater. There is one auxiliary feed, a duplicate of the main feed. One fire and bilge,  $7\frac{1}{2}$  inches— $4\frac{1}{2}$  inches by 10 inches horizontal duplex, with suctions from the sea, engine-room bilge, bilge manifold and fresh-water tanks, and discharge to the fire main, ash ejector, condenser, salt-water sanitary system and overboard. One salt-water sanitary with suction from sea, and discharge to salt-water system and crosshead guides. One fresh-water sanitary with suction from the fresh-water tanks. There is also fitted one  $1\frac{1}{2}$ -inch injector. Many of the valves are of Starr Brass Company's make.

The vessel is fitted with two double stacks having a total height of about 44 feet above the grates.

The steam pressure is 225 pounds, furnished by four Almy boilers. Each of these boilers has a grate area of 40.49 square feet, with 1,553 square feet of heating surface, and measures 93 3/32 inches wide, 89 7/8 inches long, 112 1/2 inches from bottom of ash-pan to top of hood, 24 inches from bottom of ash-pan to top of grate, 30 inches from top of grate to crown of fire-box. Weight, without water, 23,000 pounds; weight, with water, 25,400 pounds. These boilers are what is known as Class E.

The ashes are handled by means of a 4-inch ash ejector of the Fore River pattern. She has 1,000 Armstrong life preservers. At the time the design was made a series of model tank tests were conducted, and from these results it could be predicted that the contract speed could be maintained. She was first standardized by making twenty runs over a measured course, the speed varying from 8 to 16 1/2 statute miles per hour. The steam pressure at the highest speed was easily maintained by the boilers. Following the standardization a four-hour run at sea was made and the contract speed of 15 statute miles per hour was readily exceeded. The owners of the *Sankaty* have put into effect their belief that true economy,

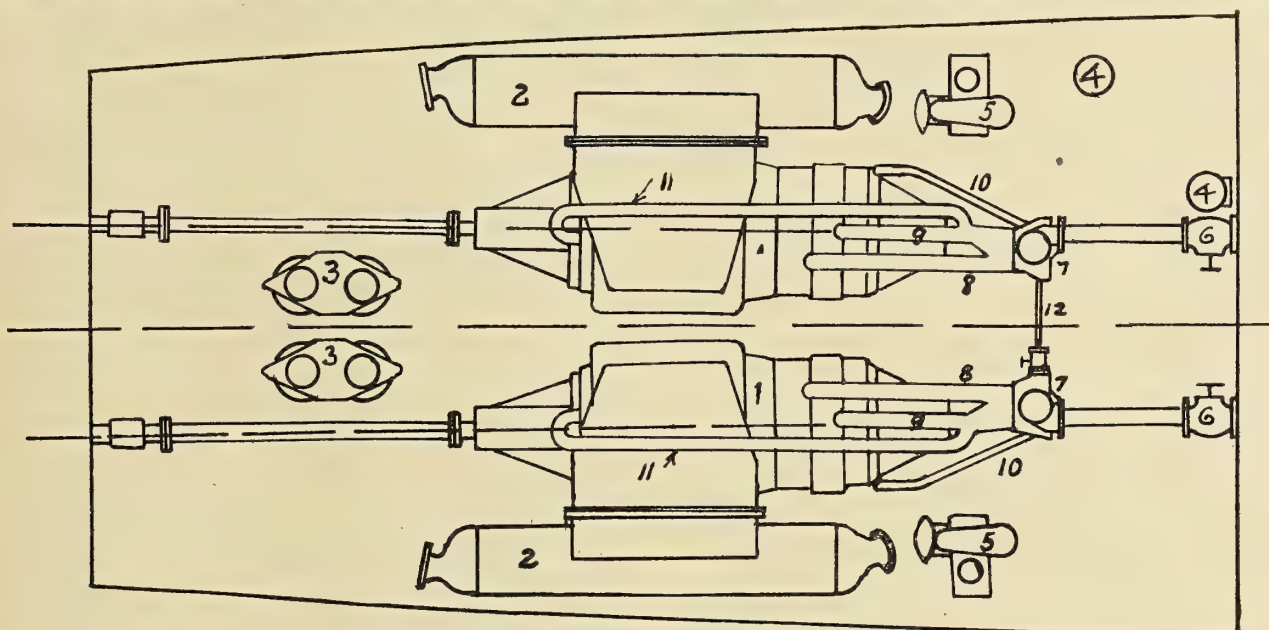
Some data and dimensions of the hull, machinery and armament are given below:

|                                     |                     |
|-------------------------------------|---------------------|
| Material .....                      | Mild steel          |
| Length between perpendiculars.....  | 289 ft. 0 ins.      |
| Length over all .....               | 293 ft. 10 1/2 ins. |
| Beam on L. W. L.....                | 26 ft. 0 1/2 ins.   |
| Mean draft .....                    | 8 ft. 4 ins.        |
| Displacement .....                  | 742 tons            |
| Block coefficient of fineness.....  | .414                |
| Capacity of oil fuel tanks.....     | 234.2 tons          |
| Capacity of reserve feed tanks..... | 14.8 tons           |
| Total horsepower, designed .....    | 13,000              |
| Speed, designed .....               | 30 knots            |

ARMAMENT.—Five 3-inch, 50-caliber, semi-automatic guns; three 5-meter by 45 centimeter deck torpedo tubes; three 3-inch guns, all of which are furnished by the Government.

PROPELLING MACHINERY.—An interesting feature about the two destroyers in question is marked by the use of the Zoelly marine turbine for the propelling machinery, and the White-Forster water-tube boiler for the steam generating plant. The *Mayrant* and *Warrington* are the first and only ships in the United States Navy having this type of machinery.

As will be noticed from the plan appended, the two turbines are placed side by side in about the middle of the engine room, with sufficient room left outboard for each condenser.



MACHINERY PLAN OF DESTROYERS.

1. Main Turbines.
2. Main Condensers.
3. Main Air Pumps.
4. Main Feed Pumps.
5. Main Circulating Pumps.
6. Main Steam Stop Valves.

7. Maneuvering Valve.
8. Steam to Ahead Turbine, max. full speed.
9. Steam to Ahead Turbine, reduced speed.
10. Steam to Ahead Turbine, cruising speed.
11. Steam to Astern Turbine.
12. Main Steam Cross Connection.

especially in boiler practice, lies in ample reserve power. This had the advantage not only of economy in fuel consumption and long life to the boilers, but gives a margin of power for use in adverse conditions of ice and weather.

### TORPEDO BOAT DESTROYERS WARRINGTON AND MAYRANT.

Among the ten destroyers authorized by Congress in May, 1908, are included the *Warrington* and *Mayrant*, of which the former has recently completed its contract trials.

The contract for the above-mentioned vessels was awarded to the Wm. Cramp & Sons' Ship and Engine Building Company, of Philadelphia, in October, 1908. The contract time was, respectively, twenty-three and twenty-four months, and the price for each was \$664,000 (£132,800), which is exclusive of equipment and certain other articles furnished by the Government.

This arrangement of the machinery allows for a comparatively large and unobstructed floor space, together with ready accessibility of the auxiliaries.

The Zoelly turbine is essentially of the impulse type, but, when used for marine purposes, where steam speeds of necessity must be low, the pure impulse action is changed in the low-pressure zone to the combined impulse-reaction system as used in Parsons turbines. The turbines installed in the *Mayrant* and *Warrington* consist, in the high-pressure zone, of twelve pressure stages, in each of which there are two velocity stages, or, in other words, two movable vane rows and one stationary row. All of these stages consist of turned steel discs fastened to the shaft, the separation of the stages being accomplished by circular diaphragms fitted tight in the casing and having a labyrinth stiffening box, each surrounding the shaft. In the low-pressure zone, where the vanes are mounted on a drum, there are four stages, the first one of which is an impulse stage with eleven rows of buckets, while the three succeeding stages are impulse-reaction with varying number of rows of buckets or vanes.

The backing part of the turbine is similar to the ahead-going part, but with a considerably smaller number of stages.

Both ahead and backing turbines are assembled within the same casing, the exhaust from both being taken out in one common exhaust nozzle connecting to the condenser. There are three direct steam connections to each ahead-going turbine and one to the backing turbine. At each steam connection the casing forms a steam belt extending the length of the arc occupied by the nozzles. The number of these nozzles vary from eighteen in the first stage, gradually increasing both in number and size until the last stage has been reached. The movable vanes extend all around the discs, while the stationary row of each stage only contains a sufficient number of vanes to properly distribute the steam coming from the nozzles to the moving vanes. The nozzles at each separate steam inlet are proportioned as to size and number in such a way as to admit a steam quantity needed to give the power corresponding to full speed, reduced speed and cruising speed of the ships.

There are no nozzle valves, all regulation of steam admission being performed by a throttle valve to each steam connection. When going ahead the turbines turn outboard, the starboard propeller being right-hand and the port propeller left-hand. As in all of the other destroyers of this class, the turbines, together with all the engine-room auxiliaries, are placed in one compartment aft of the boilers. The main steam line operating valves are connected with a steam manifold fastened to the front of columns with brackets between the forward engine-room bulkhead and the turbines. The operator thus faces the turbine while manipulating the valves. Each steam manifold connects by pipe through a main stop valve on the bulkhead to a line of main steam pipes running on each side of the ship.

**AUXILIARIES.**—There are two main twin, single-acting air pumps placed aft, one on each side of the center line of the ship, between the two shafts. Engine-driven circulating pumps are placed immediately forward of the condensers. The two main feed pumps are placed forward in the engine room.

The condensers are box shaped with semi-cylindrical top and bottom. The tubes are  $\frac{5}{8}$ -inch diameter by 15 feet 2 inches long between tube sheets, the total tube surface in each condenser being 5,002 square feet. The cooling water enters at the bottom and leaves at the top, while the exhaust steam circulates around the tubes in an opposite direction. A direct air pump suction pipe from the bottom of each condenser connects to each air pump, the two pump channels being inter-connected by a cross-pipe fitted with a sluice valve.

There are also placed in the engine room evaporators and distiller, feed heater, two 5-kilowatt Curtis turbine-driven dynamo sets, lubrication oil pumps, oil cooler with circulating pump, fire and bilge pump, feed tank and an auxiliary condenser. In each fire room are located two Terry turbine-driven, forced-draft blowers.

**BOILERS.**—Four White-Forster water-tube boilers are placed in two separate compartments with one fire room between each pair of boilers. They are made for burning oil only, and are designed for a working pressure of 250-pound gage. They are not arranged with superheaters. The tube-heating surface in each boiler is 4,500 square feet. The circulation of the gases of combustion in the White-Forster boiler is similar to that of the Yarrow. The constructional feature which distinguishes this boiler from others is to be found in the curved tubes, which are set at such angle in the tube sheet that any one tube may be removed without disturbance to other tubes, through the manhole placed on the front head of the boiler drum. All boiler tubes are made of seamless, cold-drawn steel of 1-inch outside diameter.

Arrangements of oil fuel tanks and oil-burning arrangement is, in general features, as well as in individual details, iden-

tical to arrangements described in various articles recently published in these columns.

There are three smokestacks, the top of which is about 33 feet over the oil burners.

The auxiliary boiler feed pumps are placed in each fire room.

**PROPELLERS AND SHAFTING.**—The propellers are cast solid and are made of manganese bronze. They have each three blades machined to give a true pitch of 6 feet 2 inches. The diameter is 6 feet 8 inches, with a projected blade area of 20.41 square feet.

The shafting is made of Class A steel forgings, 7 inches diameter and solid.

**TRIAL DATA.**—The standardization trial of the *Warrington* was made on a course off Delaware Breakwater on Jan. 11 last. The official speed trials were performed Jan. 12, 15 and 16, when a four-hour full-speed trial, a 25-knot trial of seven hours, and a 16-knot trial of ten hours were run.

#### FOUR-HOUR FULL-SPEED TRIAL.—

|                                                                          |             |
|--------------------------------------------------------------------------|-------------|
| Average pressure at boilers, gage.....                                   | 246 lbs.    |
| Average pressure at engine room, gage.....                               | 238.7 lbs.  |
| Average pressure at turbine, first steam belt, slow speed, gage.....     | 142.9 lbs.  |
| Second, medium speed, gage.....                                          | 144.6 lbs.  |
| Third, full speed, gage.....                                             | 191.7 lbs.  |
| Average vacuum, inches.....                                              | 28.95       |
| Average pressure in fire room, ins. water.....                           | 4.85        |
| Average revolutions per minute of forced-draft blowers in fire room..... | 1,212       |
| Average pressure in lubricating oil system.....                          | 21.1 lbs.   |
| Average double strokes, main air pumps.....                              | 46          |
| Average revolutions per minute, main circulating pumps.....              | 355         |
| Average temperature, injection.....                                      | 45.5° F.    |
| Average temperature, discharge.....                                      | 75.0° F.    |
| Average revolutions per minute, turbines.....                            | 641         |
| Slip of propellers, mean.....                                            | 22.8        |
| Total shaft horsepower.....                                              | 1,2846      |
| Mean displacement on trial.....                                          | 729.2 tons. |
| Pounds of water per hour per horsepower, all purposes.....               | 14.54       |
| Pounds of fuel oil per hour per shaft horsepower.....                    | 1.392       |
| Pounds of water evaporated per hour per pound of fuel oil.....           | 10.44       |
| Nautical miles run per ton of fuel oil.....                              | 3.774       |
| Speed per hour, knots.....                                               | 30.123      |

#### SEVEN-HOURS 25-KNOT SPEED TRIAL.—

|                                                                      |          |
|----------------------------------------------------------------------|----------|
| Average pressure at boilers, gage.....                               | 246 lbs. |
| Average pressure at engine room, gage.....                           | 241 lbs. |
| Average pressure at turbine, first steam belt, slow speed, gage..... | 165.8    |
| Second, medium speed, gage.....                                      | 195.1    |
| Third, full speed, gage.....                                         | 85.0     |
| Average vacuum, inches.....                                          | 29       |
| Average pressure in fire room, in inches of water.....               | 3.2      |
| Total shaft horsepower.....                                          | 7803     |
| Average revolutions per minute of turbines.....                      | 502      |
| Speed per hour, knots.....                                           | 25.926   |
| Pounds of water per hour per horsepower, all purposes.....           | 15.88    |
| Pounds of fuel oil per shaft horsepower per hour.....                | 1.381    |
| Pounds of water evaporated per hour per pound of fuel oil.....       | 11.48    |
| Nautical miles run per ton of fuel oil.....                          | 5.388    |
| Average displacement on trial.....                                   | 735 tons |

#### TEN-HOUR 16-KNOT SPEED TRIAL.—

|                                                                      |            |
|----------------------------------------------------------------------|------------|
| Average pressure at boilers, gage.....                               | 248.5 lbs. |
| Average pressure at engine room, gage.....                           | 245.5 lbs. |
| Average pressure at turbine, first steam belt, slow speed, gage..... | 171.7 lbs. |
| Second, medium speed, gage.....                                      | 5.3 lbs.   |
| Third, full speed, gage.....                                         | 13.95 lbs. |
| Average vacuum, inches.....                                          | 29.23      |
| Average pressure in fire room, in inches of water.....               | 1.38       |
| Total shaft horsepower.....                                          | 1607       |
| Average revolutions per minute of turbines.....                      | 291.7      |
| Speed per hour, knots.....                                           | 16.26      |
| Pounds of water per hour per horsepower, all purposes.....           | 21.996     |
| Pounds of fuel oil per hour per shaft horsepower.....                | 2.189      |
| Pounds of water evaporated per hour per pound of fuel oil.....       | 10.04      |
| Nautical miles run per ton of fuel oil.....                          | 10.355     |
| Average displacement on trial.....                                   | 726.6 tons |

The foregoing article, together with two others, having appeared at different times in these columns, finishes a series of articles in which have been described the general features of the propelling machinery and boilers, and in which have also been given the principal trial data of three destroyers of the same class and dimensions as regards hull, but all having machinery of different type. The destroyers thus described are the *Preston*, with Parsons turbines and Thornycroft boilers; the *Perkins* and *Sterret*, with Curtis turbines and Yarrow boilers, and the *Margrant* and *Warrington*, with Zoelly turbines and White-Forster boilers.

### Interesting Propeller Experiments.

Prof. Oswald Flamm, of the Technical High School of Charlottenburg, has made some most interesting experiments with screw propellers with a view of finding out the effect on the water through which they passed. The series of illustrations we give from his book are novel and highly interesting and instructive. It is to be regretted that more means were not placed at the disposal of the professor so that he could carry out his work to his liking, but this condition is a most

boats, express boats, packets and yachts, and altogether were thirteen in number. Some of the special wheels were designed by Professor Flamm. The revolutions of the propellers were from 2,000 to 3,000 per minute. In taking the photographs the exposures were approximately one-thousandth of a second each. In the trials the carriage was loaded with various weights, but Professor Flamm does not express himself as very well satisfied with the records he obtained as to the power required to move a given load at a given speed under the conditions.



FIG. 1.

unfortunate one, that far too often exists under similar circumstances.

Professor Flamm calls attention to the lack of accurate knowledge concerning just what can be obtained from a propeller. He wishes to obtain the effect on the water in front of the propeller, at the propeller and in its wake. In order to do this he could not trust to human vision, or can human vision record what it sees. He, therefore, had recourse to photography, which can not only see, but makes a thorough record of what is seen. He also called into use that most convenient form of power, electricity. Owing to limited apparatus and means he could not make all the records that he desired and he experienced considerable difficulty in recording the exact powers exerted. His experimental tank was

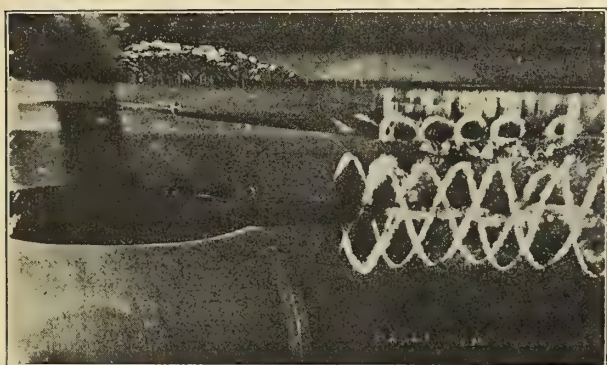


FIG. 3.

10 meters long (393 feet), 8 meters wide (26 feet 2 inches), and 6 meters deep (19 feet 8 inches). The tank was of plate-glass and he used filtered water. In order to obtain a view of the propellers glass sides and bottoms were necessary and, of course, clear water could only be employed. Into this water he threw the rays of a searchlight of some 24,000 candle-power. Above the tank he erected a track and mounted on it a truck, and from this apparatus extended down into the water an arm or strut which carried the propeller and its motor. These propellers were in various forms, but not freaks. They were such as were used in torpedo boats, tow-

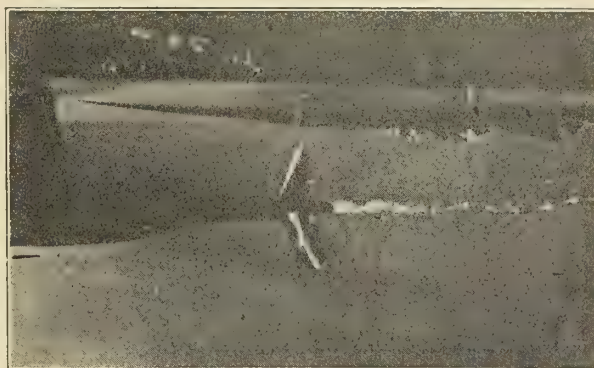


FIG. 2.

Examination of the photographs shows some interesting features. The illustration marked Fig. 1 clearly brings out the drawing down or suction of the water just above the screw. In the experiment when this photograph was taken the carriage was weighted with 20 kilograms (24 pounds) and the propeller was three-bladed, making 3,600 revolutions, and the advance of the carriage is noted as slow.

The illustration, Fig. 2, with a weight of 4 kilograms (8.8 pounds) and 2,500 revolutions of speed of 2.45 meters per second (9.6 feet) the suction loses the peak effect and shows

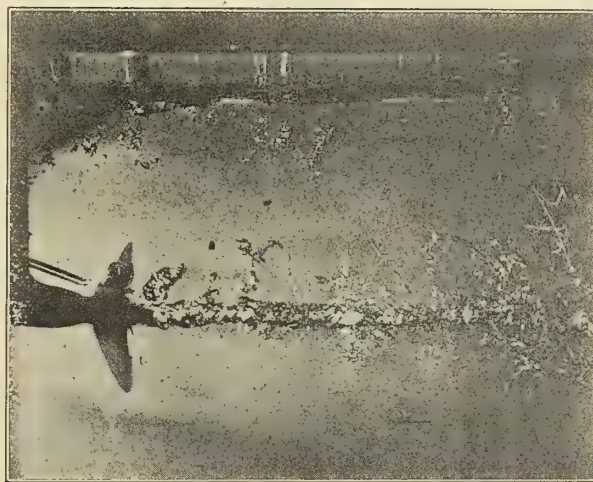


FIG. 4.

a more elongated depression, keeping practically parallel with the surface of the water after leaving the point immediately above the blade of the propeller. There are no detailed descriptions or drawings of the carriage or transmission mechanism, but it is not at all difficult to conceive of many satisfactory plans which could be carried out under the circumstances. The carriage was fitted with a strut carrying a torpedo-shaped body at the stern, on which was fitted the screw. Of course, the strut was a thin fore-and-aft cross-section and faired with great care.

Illustration Fig. 3 has no data given as to the revolutions,

etc., but the spiraling effect in the water is splendidly shown, and here again the sucking down above the screw is brought out. With a four-bladed propeller the effect, as shown in Fig. 4, is interesting. Here 1 kilogram (2.204 pounds) was the weight on the carriage. The screw turned 1,250 revolutions and a speed of 1.2 meters (4.72 feet) was obtained, and the curious "ropy" effect of the water is interesting to note.

The professor calls attention to the fact which we all have suffered from more or less, and that is, with the utmost care the propeller is almost always a trial and error problem. Certain conditions being given, a propeller wheel can be designed to do certain things, but there always seems to be a pleasant smile on the face of those who "chase the x's" and produce the drawing of the wheel, when results approximately coincide with what was sought, and it is somewhat strange that so often the hoped-for result is exceeded. The smile broadens, but good engineering can only be obtained by exact data, and, while we are often assured by experts that wheels

and are located at its New York Navy Yard. The remaining 2 are the property of a private shipbuilding company, and are at its yards in Erie Basin.

Of the 72 floating docks, 50 are "balance" or single pontoon docks; 20 are sectional, or of the multiple pontoon type, and 2 are "mud" or open end box docks, and all are private property.

Of the floating docks, the largest is that of the Morse Dry Dock & Repair Company, having a claimed lifting capacity of 15,000 tons. It is of the sectional type, having five pontoons, each of which is provided with a duplicate pumping outfit operated electrically. It has a hull length of 408 feet and a deck length of 478 feet, the difference being made up with an overhanging deck or outrigger at each end. Between wings, it has a top width of 120 feet, and a deck width of 103 feet. The dock is entirely of wood and lies between two piers, which serve to hold it in position.

The second in size is a sectional dock at the yards of Tietjen & Lang, Hoboken, N. J., which has a lifting capacity



LOCATION OF DOCKS IN NEW YORK HARBOR.

can be, without question; properly designed, there seems to be a great amount of docking done to replace propellers. In other words, we really consider that with the present knowledge we cannot call the design of a propeller an exact art, and it is to be hoped that further investigations of Professor Flamm can be made to put us in possession of facts to correct this conditions.

of 9,000 fons. It is built entirely of wood, has five sections or pontoons, which make up a hull length of 408 feet and a deck length of 468 feet, including the outriggers. Between wings it has a top width of 98 feet and a deck width of 98 feet. The dock is entirely of wood and lies between guide piers.

In the following order are the twelve firms having the largest floating dock tonnage facilities:

DOCKING FACILITIES OF THE PORT OF NEW YORK.\*

For docking vessels at the Port of New York, there are provided, in all, 92 appliances. Of this total, 6 are graving or fixed location basins, 72 are floating hulls or pontoons, and 14 are marine railways.

Of the 6 graving docks, 4 belong to the United States

\*Compiled by Frederick O. Harris, Civil Engineer, U. S. Navy, assisted by C. F. Bonner.

| Name.                                  | Largest Single Dock Tons. | Total Number Docks. | Total Tonnage. |
|----------------------------------------|---------------------------|---------------------|----------------|
| Tietjen & Lang.....                    | 9,000                     | 9                   | 24,200         |
| J. N. Robbins Co *.....                | 6,000                     | 3                   | 16,000         |
| Morse Dry Dock and Repair Co.*.....    | 15,000                    | 1                   | 15,000         |
| J. Shewan & Sons.....                  | 5,500                     | 6                   | 12,500         |
| Staten Island Ship Building Co.....    | 4,000                     | 5                   | 10,800         |
| Theo. Crane's Sons.....                | 5,000                     | 3                   | 8,000          |
| Raritan Dry Dock Co.....               | 4,500                     | 3                   | 6,140          |
| J. Tregarthus Son.....                 | 3,000                     | 3                   | 6,000          |
| W. J. Cakey & Co.....                  | 3,000                     | 3                   | 5,200          |
| F. McWilliams.....                     | 2,000                     | 4                   | 4,000          |
| Perth Amboy Dry Dock Co.....           | 2,500                     | 3                   | 3,700          |
| McAllister Dry Dock & Ship Yard Co.... | 1,500                     | 3                   | 2,700          |

\* Has also two graving docks. † The lifting capacity given for this dock is that claimed by the owner and has not been checked by the writer.

The two privately owned graving docks are at the ship yard of the J. N. Robbins Company, Beard street and Erie Basin, Brooklyn. One of these has a top length of 515 feet,

sill depth of 25 feet. Both docks are of the Simpson type, originally of wood throughout, though the smaller has been largely renewed with concrete. Both docks have the floor

## DOCKING FACILITIES, PORT OF NEW YORK.

| Key No. | Location.                                         | Owner.                                     | Kind of Dock.           | Capacity |        | Length |      |
|---------|---------------------------------------------------|--------------------------------------------|-------------------------|----------|--------|--------|------|
|         |                                                   |                                            |                         | Tons.    | Draft. | Deck.  | Box. |
| 1       | Brooklyn, N. Y.<br>Foot Sands Street.....         | United States Government.....              | Graving Dock.....       | .....    | 25     | 347    | 320  |
|         |                                                   |                                            |                         | .....    | 26     | 471    | 440  |
|         |                                                   |                                            |                         | .....    | 29     | 648    | 605  |
|         |                                                   |                                            |                         | .....    | 35     | 703    | 700  |
| 2       | Erie Basin.....                                   | J. N. Robbins & Co.....                    | Graving Dock.....       | .....    | 21     | 515    | 483  |
|         |                                                   |                                            | Floating Sectional..... | 6,000    | 25     | 612    | 578  |
|         |                                                   |                                            | Floating Sectional..... | 6,000    | 17     | 375    | 375  |
|         |                                                   |                                            | Floating Sectional..... | 4,000    | 21     | 400    | 400  |
| 3       | Conover Street.....                               | Schuyler & Caddell.....                    | Floating Balanced.....  | 500      | 17     | 330    | 330  |
|         |                                                   |                                            | Floating Sectional..... | 500      | 12     | 130    | 105  |
|         |                                                   |                                            | Marine Railway.....     | 1,500    | 15     | 287    | ...  |
|         |                                                   |                                            |                         | 800      | 9      | 187    | ...  |
| 4       | Erie Basin.....                                   | Theo. A. Crane's Sons Co.....              | Floating Sectional..... | 2,000    | 18     | 235    | 205  |
|         |                                                   |                                            | Floating Balanced.....  | 5,000    | 20     | 358    | 300  |
| 5       |                                                   | Wm. J. Gokey & Co.....                     | Floating Sectional..... | 1,000    | 18     | 265    | 191  |
|         |                                                   |                                            | Floating Sectional..... | 1,000    | 16     | 180    | 130  |
|         |                                                   |                                            | Floating Sectional..... | 1,200    | 12     | 188    | 160  |
|         |                                                   |                                            | Floating Balanced.....  | 3,000    | 18     | 265    | 191  |
| 6       | Foot Smith Street.....                            | Furman & Birkland.....                     | Floating Sectional..... | 500      | 10     | 120    | 120  |
| 7       | Foot Court Street.....                            | Downing & Lawrence.....                    | Marine Railway.....     | 800      | 10     | 230    | ...  |
|         |                                                   |                                            |                         | 800      | 10     | 230    | ...  |
| 8       | Foot 20th Street.....                             | Ira S. Bushey.....                         | Floating Balanced.....  | 1,000    | 14     | 170    | 110  |
| 9       | Foot 23d Street.....                              | Tebo Yacht Basin Co.....                   | Floating Balanced.....  | 800      | 13     | 90     | 90   |
| 10      | Foot 26th Street.....                             | Jas. Shewan & Sons, Inc.....               | Floating Sectional..... | 1,600    | 17     | 190    | 150  |
|         |                                                   |                                            | Floating Sectional..... | 5,500    | 23     | 396    | 357  |
| 11      | Foot 56th Street.....                             | Morse Dry Dock and Repairing Co.....       | Floating Sectional..... | 500      | 16     | 160    | 120  |
| 12      | Long Island City, N. Y.<br>Hunters Point.....     | McWilliams Bros.....                       | Floating Sectional..... | 15,000   | 28     | 478    | 400  |
| 13      | Astoria.....                                      | Ward & Co.....                             | Floating Balanced.....  | 375      | 13     | 150    | 100  |
|         |                                                   |                                            | Floating Sectional..... | 250      | 13     | 120    | 100  |
|         |                                                   |                                            | Marine Railway.....     | 1,000    | 8      | 175    | ...  |
|         |                                                   |                                            |                         | 1,000    | 8      | 175    | ...  |
| 14      | New York City, N. Y.<br>Houston Street, E. R..... | Jas. Shewan & Sons.....                    | Floating Balanced.....  | 3,500    | 25     | 276    | 206  |
|         |                                                   |                                            |                         | 2,500    | 22     | 240    | 190  |
|         |                                                   |                                            |                         | 800      | 16     | 180    | 140  |
|         |                                                   |                                            |                         | 700      | 16     | 160    | 120  |
| 15      | Foot 7th Street, E. R.....                        | Jas. Tregarthen, Son & Co.....             | Floating Balanced.....  | 1,000    | 16     | 191    | 135  |
|         |                                                   |                                            |                         | 3,000    | 20     | 250    | 185  |
|         |                                                   |                                            |                         | 2,000    | 19     | 231    | 162  |
| 16      | Staten Island, N. Y.<br>Mariners Harbor.....      | Rankin Dry Dock Co.....                    | Floating Balanced.....  | 1,500    | 15     | 185    | 130  |
| 17      |                                                   | The Staten Island Shipbuilding Co.....     | Floating Balanced.....  | 2,500    | 18     | 220    | 165  |
|         |                                                   |                                            |                         | 1,500    | 15     | 185    | 130  |
| 18      |                                                   | Brewer Dry Dock Co.....                    | Floating Sectional..... | 500      | 12     | 140    | 118  |
| 19      |                                                   | Shooter's Island Shipbuilding Co.....      | Marine Railway.....     | 4,500    | 19     | 385    | ...  |
| 20      |                                                   | Caddell Bros.....                          | Floating Sectional..... | 500      | 10     | 150    | ...  |
| 21      | West Brighton.....                                | Staten Island Shipbuilding Co.....         | Floating Balanced.....  | 4,000    | 22     | 304    | 212  |
|         |                                                   |                                            |                         | 1,800    | 18     | 200    | 151  |
|         |                                                   |                                            |                         | 1,000    | 16     | 190    | 141  |
| 22      |                                                   | McAllister Dry Dock & Shipbuilding Co..... | Floating Sectional..... | 1,500    | 15     | 225    | 200  |
|         |                                                   |                                            |                         | 700      | 13     | 125    | 125  |
|         |                                                   |                                            | Floating Balanced.....  | 500      | 12     | 125    | 100  |
| 23      |                                                   | Frank McWilliams.....                      | Floating Balanced.....  | 2,000    | 18     | 209    | 152  |
|         |                                                   |                                            |                         | 1,000    | 18     | 190    | 120  |
|         |                                                   |                                            |                         | 500      | 13     | 130    | 100  |
|         |                                                   |                                            |                         | 500      | 13     | 123    | 101  |
| 24      | Tottenville.....                                  | J. S. Ellis & Sons.....                    | Marine Railway.....     | 250      | 6      | 120    | ...  |
| 25      |                                                   | A. C. Brown.....                           |                         | 1,000    | 14     | 200    | ...  |
| 26      | City Island, N. Y.....                            | Robt. Jacob.....                           |                         | 1,000    | 20     | 165    | ...  |
|         |                                                   |                                            |                         | 600      | 12     | 120    | ...  |
|         |                                                   |                                            |                         | 650      | 12     | 85     | ...  |
| 27      | Hoboken, N. J.<br>Weehawken.....                  | Union Dry Dock and Repair Co.....          | Floating Sectional..... | 1,900    | 17     | 216    | 190  |
|         |                                                   |                                            | Floating Balanced.....  | 1,000    | 12     | 130    | 120  |
|         |                                                   |                                            |                         | 600      | 13     | 158    | 100  |
| 28      |                                                   | The Weehawken Dry Dock Co.....             | Floating Sectional..... | 1,000    | 12     | 135    | 135  |
| 29      | 17th Street, N. R.....                            | The Tietgen & Lang Dry Dock Co.....        | Floating Balanced.....  | 800      | 13     | 140    | 100  |
|         |                                                   |                                            |                         | 2,000    | 18     | 236    | 176  |
|         |                                                   |                                            | Floating Sectional..... | 1,000    | 15     | 172    | 121  |
|         |                                                   |                                            | Floating Balanced.....  | 1,200    | 14     | 189    | 149  |
|         |                                                   |                                            |                         | 1,800    | 18     | 229    | 169  |
|         |                                                   |                                            | Floating Sectional..... | 9,000    | 22     | 468    | 408  |
|         |                                                   |                                            | Floating Balanced.....  | 1,400    | 18     | 190    | 130  |
|         |                                                   |                                            |                         | 1,000    | 16     | 184    | 134  |
|         |                                                   |                                            |                         | 6,000    | 22     | 330    | 250  |
| 30      | Jersey City, N. J.....                            | Alex Miller & Bro.....                     | Floating Balanced.....  | 2,000    | 18     | 185    | 143  |
|         |                                                   |                                            | Floating Sectional..... | 1,000    | 14     | 138    | 126  |
| 31      |                                                   | Burt & Mitchell.....                       | Floating Balanced.....  | 750      | 15     | 171    | 131  |
| 32      |                                                   | Theo. Smith & Son.....                     |                         | 1,100    | 15     | 181    | 131  |
| 33      |                                                   | W. T. Hanley.....                          | Floating Sectional..... | 600      | 10     | 130    | 120  |
| 34      |                                                   | O'Donnell Anderson Dry Dock Co.....        | Floating Balanced.....  | 600      | 12     | 137    | 122  |
| 35      |                                                   | Jno. Swenson.....                          |                         | 1,000    | 14     | 175    | 125  |
|         |                                                   |                                            |                         | 500      | 12     | 130    | 90   |
| 36      |                                                   | B. Long & Son.....                         |                         | 1,100    | 11     | 145    | 110  |
| 37      |                                                   | Morton & Rankin.....                       | Floating Mud.....       | 800      | 10     | 120    | 120  |
|         |                                                   |                                            |                         | 800      | 10     | 120    | 120  |
| 38      |                                                   | Patrick O'Rourke.....                      | Floating Sectional..... | 400      | 9      | 90     | 90   |
| 39      | Elizabeth Port, N. J.....                         | The New Jersey Dry Dock Co.....            | Marine Railway.....     | 1,500    | 10     | 225    | ...  |
|         |                                                   |                                            | Floating Balance.....   | 400      | 14     | 163    | 121  |
| 40      | Perth Amboy, N. J.....                            | Perth Amboy Dry Dock Co.....               | Floating Balance.....   | 700      | 14     | 160    | 160  |
|         |                                                   |                                            |                         | 2,500    | 18     | 250    | 250  |
|         |                                                   |                                            |                         | 500      | 12     | 125    | 125  |
| 41      |                                                   | The Raritan Dry Dock Co.....               |                         | 500      | 10     | 130    | 100  |
|         |                                                   |                                            |                         | 1,500    | 14     | 207    | 157  |
|         |                                                   |                                            |                         | 4,500    | 20     | 312    | 250  |

a bottom length of 483 feet, a top and bottom entrance width of 98 feet and 46 feet, respectively, and a N. H. W. sill depth of 21 feet; the other has a top and bottom length, respectively, of 612 feet and 578 feet, a top entrance width of 85 feet, a bottom entrance width of 45 feet, and a N. H. W.

level with the sill, and they conform generally to the usual types of graving docks.

All of these establishments have machine, forging and wood-working shops, and are equipped for repair business. Of the firms having small docks, several do largely a yacht and

pleasure craft business; others confine their operations to barge and scow building and repairs, while in other cases the docks are an adjunct to the larger operations of machine, forge and boiler shop business.

Of the marine railways, the largest, which is now shut down, is that of the Shooters Island Shipbuilding Company at Mariners Harbor, S. I., with a cradle length of 385 feet, and a tonnage capacity of 4,500. This firm has a well-equipped plant for general shipbuilding and repair work, but is not now actually engaged in business.

The other railways are much smaller and do building and repair work within the capacity of their plants.

Among those firms having facilities for handling large vessels, there is a generally accepted schedule of dockage charges for vessels whose tonnage rates amount to fifty dollars or more per day. For vessels of smaller size, the charges are contingent upon circumstances, and there seems no generally applied rate.

The following tariff applies generally to all large vessels, the rates being per gross ton; cargo and removable ballast being charged for in some cases, while in others the basis is the gross ton register as given in Lloyds. The first day, 8 cents per ton; the second, third, fourth and fifth days, 7 cents per ton; all subsequent days, 6 cents per ton, but no charge shall be less than \$50. Five or more continuous hours constitute one day. One hour and less than five hours constitute one-half a day. Lay days on which no work can be done on account of bad weather are at half price. Sundays and holidays are free, unless work is performed, in which event full rates obtain. Docking time begins when the vessel enters the mouth of the dock, and continues until it has cleared the same. Vessels lying in dock for the account of the dock company do so without charge.

The following regulations govern the use of the docks of the United States Government by other than its own ships (See Art. 926, 4, 5, 6, 7, of the regulations):

"No work shall be done by the Government force at a Navy Yard or Station for private individuals or corporations, except by authority of the Secretary of the Navy, upon application specifying the nature of the work to be done, and accompanied by a certificate from the Commandant, that *the necessary labor and appliances cannot be procured in the vicinity from private contractors.* Where work is authorized at a Navy Yard or Station for private parties, they shall deposit with the Paymaster of the Yard, a sum sufficient to cover the estimated expenses to be incurred. The total cost shall be defrayed from such deposit. The special deposit for payment shall be made by check payable to the order of the Commandant of the Yard or Station, and by him endorsed to the Paymaster of the Yard. . . . Any balance of the special deposit remaining in the hands of the Paymaster shall be returned by check to the party making the deposit. The "charging" rates current in the vicinity shall be used in fixing the cost of private work, which shall not be less than the actual expense to the Government. Tools, power, light, etc., shall be included in the cost, and the rates for such appliances, etc., shall be those charged per hour in the vicinity, but in no case less than the cost to the Government therefor. In docking private vessels at Navy Yards or Stations, the usual rates per gross ton register for docking and maintaining in dock current in the vicinity shall be charged, provided, however, that no such charge shall be less than the actual cost."

The following is the schedule of charges for private individuals or corporations using the Government dry docks at the New York Navy Yard:

For docking vessels in Dry Docks Nos. 1 and 2, the charges will be:

- (a) For steamers, 5 cents per gross ton for docking (including undocking).  
For sailing vessels, 5 cents per net ton for docking (including undocking).
- (b) For steamers, 5 cents per gross ton per lay day.  
For sailing vessels, 5 cents per net ton per lay day.  
For docking vessels in Dry Dock No. 3, the charges will be:
  - (a) For steamers, 8 cents per gross ton for docking (including undocking).  
For sailing vessels, 8 cents per net ton for docking (including undocking).
  - (b) For steamers, 8 cents per gross ton per lay day.  
For sailing vessels, 8 cents per net ton per lay day.

Lloyd's Register of Shipping for the quarter ending March 30, 1911, states the world's tonnage building, not including the United Kingdom, is 649,132 in 287 vessels. The gross tonnage built in the United Kingdom amounts to 1,374,964 in 480 vessels, 317,000 tons greater than reported in the previous twelve months. The war tonnage of the United Kingdom was 384,740 in 65 vessels, which is the highest on record for the past ten years. The commercial tonnage of the United States is 98,863 tons in 54 vessels. Germany leads all but England, with 67 vessels of 215,557 tons, France following with 29 vessels of 123,690 tons.

The Chilean government has, either under construction or contract, extensive navy yards and harbor improvements at Talcahuano, consisting of machine shops, a large new dry-dock and extensive breakwater and harbor works. When these improvements are completed the government will have a well-equipped naval station and one of the best harbors on the Pacific Ocean south of San Francisco. These improvements will cost very close to \$10,000,000 gold, and it will require about three and one-half years to complete them. Nearly everything about the naval machine shops is English.

The article on page 148 of our April issue, entitled "Stability of Merchant Vessels," through an oversight, did not have the author's name attached to it. This article was written by Mr. George Nicol. In the article the symbol "Z" is used in one or two instances in place of "Y."

The new Hamburg-American steamship, whose name has been changed from *Europa* to *Imperator*, is to have forty-six watertube boilers of the modified Thornycroft type. The propelling power will be four Parsons turbines modified in several ways, such as including the go-ahead and the astern turbines in the same casing. The ship will have three funnels, two for boiler draft and one solely for ventilation. It is expected that this one funnel will make it possible to do away with all ventilating cowls. By the use of watertube boilers it is expected to save at least 3,000 tons in the weight of the ship.

## GRAPHICAL SHIP CALCULATIONS

Ship calculations in nearly all cases are made by the aid of integrating rules, such as Simpson's, Tchebycheff's or Borda's, which can give only an approximate result. For all these rules are gained by substituting a curve of mathematically expressible character for the original curve, as it is laid down in the drawing of the ship's forms. Much more correct results can be ascertained by graphical calculations, which, moreover, will very often effect a saving of time, especially

with ships whose ends are cut away to a considerable extent, such as motor boats and yachts.

To show how to arrange such a graphical calculation, the displacement, centers of buoyancy and waterline, metacenter and moment to change trim of the boat below shall be calculated. The dimensions are as follows:

|                          | Feet. |
|--------------------------|-------|
| Length over all.....     | 44.6  |
| Length of waterline..... | 39.4  |
| Extreme breadth .....    | 9.85  |
| Draft .....              | 3.28  |

On the horizontal base line  $BB$  (Fig. 3) the distances of the sections shown in the body plan are marked and vertical lines drawn through these points. The areas of the sections are found by planimeter from the body plan, and set off on their respective lines in a convenient scale. Thus we get curve 3, Fig. 3, the area of which represents the displacement of the boat. This is only calculated up to waterline 4, and the area of the curve is 2.868 square inches. As the scales are, horizontally, 1 inch = 8.33 feet; vertically, 1 inch = 13.67 square feet, we must multiply the area of the curve by  $8.33 \times 13.67$  to have the displacement in cubic feet,  $2.868 \times 8.33 \times 13.67 = 326.67$  cubic feet.

To obtain the longitudinal position of the center of buoyancy with respect to a suggested cross plane, the moment of the curve of displacement with respect to this plane is determined graphically in the following manner:

Take two of the vertical lines ( $UU$  in Fig. 3) at equal distances from the fixed cross plane 6. From any point of the displacement curve draw a horizontal line (such as  $PF$  and  $QF$ ) to meet  $UU$ ; further draw the straight lines  $O-F-PM$ ,  $O-F-QM$ . Thus every point, such as  $P$  and  $Q$ , of the displacement curve produces a point as  $PM$  and  $QM$  on its vertical line, and the curves 4 are found. The area under the part of curve 4 to the left of cross plane 6, multiplied by the distance between  $UU$  and  $YY$ , represents the moment of the part of the displacement curve aft of cross plane 6, and the area of that part of curve 4 to the right of 6, multiplied by the same distance, represents the moment of its fore part.

This method of drawing moment curves was devised by Nehls, and can be proved by referring to Fig. 2. The moment of the curved area  $AOB$ , with respect to the  $Y$  axis, shall be found. Take a strip,  $FGHI$ , of this area so narrow that the curved piece  $HI$  may be taken as straight. The moment of that strip is the product of its area  $FGHI$  multiplied by the lever  $l$ , or ( $KL$  being the mean height of the strip)  $FG \times KL \times l$ . Draw the line  $UU$  parallel to the  $Y$  axis and at a distance  $d$  from it, and close the figure by drawing  $KP$  and  $OPM$ . Now the following relation exists between  $LM$ ,  $PU$ ,  $l$  and  $d$ ,  $OML$  and  $OPU$  being similar triangles:

$$LM : PU = l : d.$$

$$LM \times d = PU \times l = KL \times l.$$

Therefore, the moment of the strip may be written  $FG \times LM \times d$ , instead of  $FG \times KL \times l$ .  $FG \times LM$  is the element strip of a new area, the boundary of which is found by constructing a new point  $M$  to every point of the original curve, as it is done with  $K$  in Fig. 2. As the moment of every element strip of the original curve is given by the product of the corresponding element strip of the moment curve, multiplied by the common distance  $d$ , the sum of the moments of all original element strips, being the moment of the whole original area, is represented by the area of the moment curve multiplied by the distance  $d$ .

In our ship calculation the moments abaft and before plane 6 are counteracting, and therefore the difference between them is the moment of the total displacement curve. Of course, the center of buoyancy lies on the side of the wider moment area.

It is not necessary to work out the moment in fourth powers of a foot, for the moment itself is scarcely required. The planimeter readings of the moment areas are simply subtracted from each other, and the remainder is divided by the planimeter reading of the displacement curve; the result, multiplied by the standard distance  $OU$ , is the distance of the center of buoyancy of the fixed cross section.

The position of the center of buoyancy below the load-waterline is found by using the curve of waterline areas 1 in the diagram, Fig. 3. The horizontal lines  $WL1$ ,  $WL2$ , etc., are spaced in a convenient scale, *e. g.*, 1 : 25, and on them the respective areas of waterlines are set off. A curve is passed through the end points, called the curve of waterline areas. By integrating this curve up to the different waterlines, the displacement below the respective waterlines is obtained. As the scales are, horizontally, 1 inch = 136.7 square feet; vertically, 1 inch = 2.083 feet, the planimeter readings in square inches must be multiplied by  $136.7 \times 2.083 = 284.8$ , to get the displacement in cubic feet. The figures from the diagram are tabulated below:

|                    | Planimeter.           | Displacement.  |
|--------------------|-----------------------|----------------|
| Up to W. L. 1..... | 0.0465 square inches. | 13 cubic feet. |
| " W. L. 2.....     | 0.186 "               | 53 "           |
| " W. L. 3.....     | 0.588 "               | 168 "          |
| " W. L. 4.....     | 1.145 "               | 326 "          |
| " W. L. 5.....     | 1.83 "                | 521 "          |

The respective displacements are set off on their corresponding waterlines, thus leading to the scale of displacement (curve 2 in diagram, Fig. 3). The area of this curve below any waterline, divided by the displacement up to that waterline, gives the distance of the respective center of buoyancy below the waterline.

To prove that, suppose  $A.W.L.$  in Fig. 4 to be the curve of waterline areas and  $Sc.D.$  the scale of displacement obtained from  $A.W.L.$  An increase in draft  $D$ ,  $D_2$  causes an increase in displacement represented by the area  $D_1 A_1 A_2 D_2$ . In the scale of displacement this increase is the difference between the displacements at drafts  $D_2$  and  $D_1$ , *i. e.*,  $D_2 B_2 - D_1 B_1 = B_2 F$ . Now, supposing  $D_1 D_2$  being small, the curves pieces  $A, A_2$  and  $B, B_2$  may be taken as straight, and therefore the area  $B_1 B_2 C_2 C_1 = B_2 F \times EG$ .  $EG$  is the distance of the displacement portion  $D_1 A_1 A_2 D_2$  or  $B_2 F$  from the waterline, or, in other words, its lever, with respect to the waterline. The area  $B_1 B_2 C_2 C_1$  therefore represents the moment of the displacement portion  $D_1 A_1 A_2 D_2$ , and as every portion of displacement is represented by a corresponding part of the area between the scale of displacement and the waterline, this whole area means the moment of displacement with respect to the waterline. It may be expressed in fourth powers of a foot, using the scales as above stated, horizontally, 1 inch = 224.28 cubic feet; vertically, 1 inch = 2.083 feet. As the planimeter gives 0.651 square inches, the moment of the displacement below  $L.W.L.$  works out at

$$0.651 \times 224.28 \times 2.083 = 304.18 \text{ feet}^4.$$

$$C.B. \text{ below } L.W.L. = \frac{304.18}{326} = 0.934 \text{ feet.}$$

The result must be drawn in according to scale. The way shown in getting it has been chosen only to have a clear connection, and may be much abbreviated. It suffices to divide the area by the length of its upper limit line, without regard to scales, the displacement being represented by this length, which is found to be 1.455 inches.

$$\frac{0.651 \text{ square inches}}{1.455 \text{ inches}} = 0.4475 \text{ inches.}$$

For, using the vertical scale in the diagram, 0.4475 inches corresponds to 0.934 feet.



transverse metacenter above *C. B.* then is

$$\frac{828}{327} = 2.63 \text{ feet.}$$

It remains to determine the moment to change trim 1 inch. For that the longitudinal moment of inertia of the load-water plane, with respect to the cross axis through its center, is required. From the waterline 5 moment curves are derived in the same way as the moment curves of the displacement curve were found, and the center of flotation determined by them. Then, taking the moment curves as new original curves, and applying on them the same construction, we find new curves (7 in the diagram), the areas of which, multiplied by the square of the distance *O U*, will give the longitudinal moment of inertia of the load-water plane with respect to the suggested axis (section 6). To get the moment of inertia, referring to the axis through the center of flotation, we must subtract  $A \times a^2$ , where *A* means the area of the load-water plane and *a* the distance of its center from the suggested axis.

After having obtained the center of flotation, we could have determined the moment of inertia with respect to the center axis direct; but that would make more trouble than the way indicated above, which is also taken from Nehl's method.

Area of half load-water plane (No. 5) 1.6 square inches = 111 square feet.

Difference between planimeter readings of moment curves, 0.45 square inches.

Center of flotation aft of section 6,

$$\frac{0.45}{1.6} \times 78.74 = 22.15 \text{ inches.}$$

Sum of areas of curves 7, 3.15 square inches.

Longitudinal moment of inertia referring to section 6,

$$3.15 \times 2 \times 6,562^2 \times 69.3^* = 18,580 \text{ feet.}$$

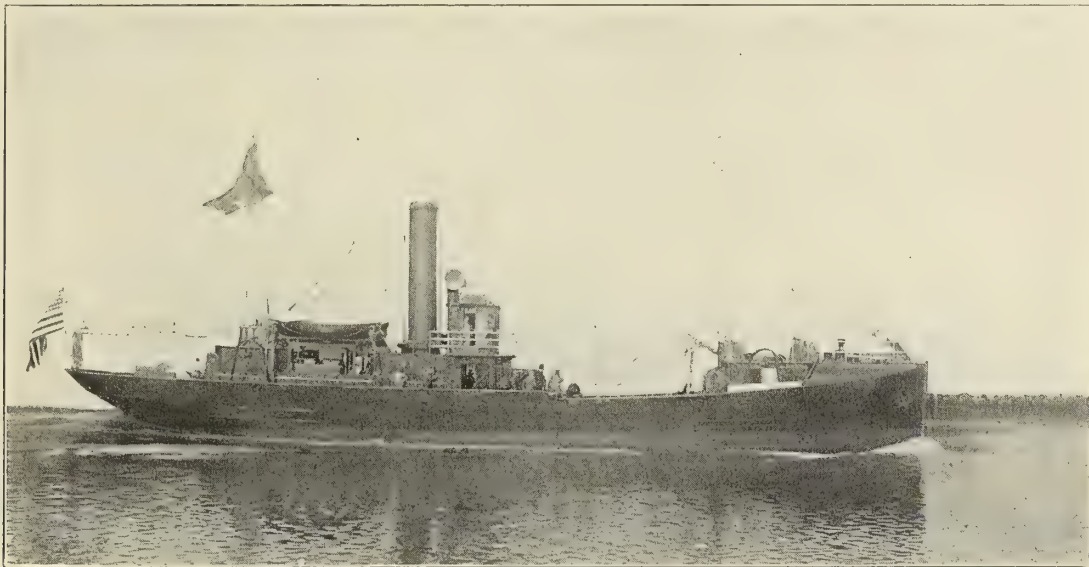
$$A \times a^2 = 690 \text{ feet.}$$

Longitudinal moment of inertia, referring to axis through center of flotation, 17,890 feet.

Moment to change trim in fresh water,

$$1 \text{ inch} : \frac{17,890}{12 \times 35 \times 39.4} = 1.08 \text{ foot tons.}$$

To calculate the displacement, centers, etc., for any other draft would simply be a repetition of the way shown for waterline 4, and therefore may be dispensed with. Some practical rules might yet be of value:



STEAM TRAWLER FOAM.

To prove its exactness, Fig. 2 must be referred to once more. In developing the proof for the moment curves we found the equation

$$L M \times d = K L \times l.$$

Regarding the similar triangles *OLN* and *O U Q*, we have

$$L N : U Q = l : d$$

$$L N \times d = U Q \times l = L M \times l = \frac{K L \times l^2}{d}$$

$$L N \times d^2 = K L \times l^2.$$

Now the moment of inertia of the element strip *F G H I*, with respect to the *Y* axis, is given by  $F G H I \times l^2 = F G \times K L \times F$ , or, substituting  $L N \times d^2$  for  $K L \times l^2$ .

$$F G H I \times l^2 = F G \times L N \times d^2.$$

The moment of inertia of every element strip is represented by the product of the element strip of a new curve multiplied by the square of the standard distance *d*, and therefore the moment of inertia of the whole original curve is given by multiplying whole the area of the derived curve by  $d^2$ .

From the diagram the following results are obtained:

1. Take the drawing paper sufficiently wide to avoid the planimeter running over the edge.

2. To simplify multiplications, take the distance *d* a simple number, but not too small, to avoid too wide areas for the moment and moment of inertia curves.

3. Add and subtract adjoining areas with the aid of the planimeter. As the base line is sometimes rather long, it is best to use planimeters of long range.

#### American-Built Steam Trawlers.

No vessel requires to be more staunchly built or more carefully designed and fitted out than the fishing boat, for at the best the fisherman's life is a hard and dangerous one. Of late years, however, the introduction of power in these boats has bettered conditions greatly. Among the most successful boats recently built, not only as regards efficiency and economy, but also as regards safety and comfort, are the steam trawlers

\* From scales.

*Spray, Ripple and Crest*, built by the Fore River Shipbuilding Company, Quincy, Mass. These boats are extremely staunch and seaworthy, being fitted with triple expansion engines and Scotch boilers. They can carry sufficient coal to steam from fifteen to sixteen days. The crew consists of eighteen men and they are most comfortably housed and the officers' quarters are luxurious. Every appliance for the fishermen's art, or trade, is supplied. An otter trawl is provided in each boat. The fish wells are able to carry about 100,000 pounds. The illustration which we give shows the design of these boats.

#### The French Steam Trawler Catherine.

The hull is of mild steel, meeting the demands for the highest class of the French *Veritas*. She is divided into five water-tight compartments, with cellular double bottom. Her entire accommodations have been studied with great care in order to give the maximum amount of comfort in the warm climate, where she is used. There is a large forecabin, in which are the firemen's, boatswains' and fishing masters' rooms. Above these is fitted a powerful steam windlass and all mooring appliances. The anchors are the latest stockless type. Below the decks are the native crew's quarters with accommodations for sixteen men; also quarters for eight white sailors. These two rooms are completely separated in order to avoid trouble between races. Below this deck is the general storeroom and chain room, also the net room. The ventilation of this part

the navigator's bridge. The cabins are all pleasingly decorated and fitted with electric lights and ventilated.

The engine is a three-cylinder triple, making 170 revolutions per minute and giving a speed on the trial trip of 14 knots. All the auxiliaries are of the very highest grade. Steam is supplied by a single-ended, cylindrical boiler of the marine type, fitted with two furnaces. The dimensions are as follows: Diameter, 13 feet 2 inches; length, 10 feet 6 inches; grate surface, 49 square feet; heating surface, 1,613 square feet. The working pressure of the boiler is 180 pounds.

The boat is yawl rigged, and has a good sail area, in case the engine is dismantled. Three life boats are fitted, which are installed by special davits of the French Navy type.

It is interesting to know that the bay of Levrier is so full of fish that it is only necessary to use the trawlers' nets for half an hour at a time and the catch is better than four hours' fishing on any part of the French coast. It is not unusual to have the net leave the bottom and come to the surface on account of the huge number of fish that are caught. The catch is usually salted for the European market. Some of it, however, is sent to Senegal, Morocco and Sahara.

#### Fuel Oil Statistics.

Oil-burning figures are remarkable, according to the daily press. On the Pacific Coast the *Pacific Mail* is equipping the *Para, Pennsylvania* and *Aztec* with oil burners, and Mr. R.



FRENCH TRAWLER CATHERINE.

of the ship has been given special attention in order to insure fresh air as far as is possible, on account of climatic conditions. The fish well is 32 feet long, to which can be added, if needed, 11 feet. The hatch is 9 feet 6 inches.

A powerful steam winch of 10 tons capacity, with all the necessary gear for handling the nets, is fitted, and is most complete. Aft of the third water-tight bulkhead is the cross bunker in the boiler room; also longitudinal bunkers with a normal capacity of 135 tons of coal. The fourth water-tight bulkhead is between the boiler and the engine rooms. Aft of the fifth water-tight bulkhead is the shaft tunnel and provision rooms; also the second engineer and mates' rooms.

A large deck house has been provided, in which are the captain's rooms, the officers' dining room, the galley, which is able to provide for thirty men, and the boiler rooms and larder. Aft of the large engine room skylight is the chief engineer's room and the entrance to the cabins below. Above the captain's room is the chart room, in which is the steering gear, and aft of which is the owner's cabin. Above these is

P. Schwerin, manager of the line, is quoted as stating that his engineers estimated a saving of \$160,000 (£32,000) per annum. The use of oil saves time. Before its use forty-five days was an average voyage between New York and San Francisco. This was cut down to twenty-four days, which is about railroad freight time, but it is only fair to say that competition had something to do with this reduction in time. To make a comparison, the American-Hawaiian steamer *Nebraskan* made the voyage from New York to San Diego, Cal., with coal in fifty-seven days five hours and forty-three minutes, burning 2,267 tons of poor coal and with a fire-room crew of fifteen men. Returning, she burned oil to the amount of 8,826 barrels, or about 1,260 tons of California oil, with but six men in the fire-room. On the outward passage, however, the *Nebraskan* made 13,280, while on the return trip she only made 12,760, the outgoing voyage being made longer by the calling at St. Lucia and Coronel for coal. By the use of oil 57 tons of cargo space was saved. The financial gain is reported by the press as \$500 (£100) per day. One chief en-

gineer, three assistants, three furnace men, three wipers, one deck engineer and six oilers were all that were required to handle the oil. The regular watch, when under way, was one engineer, two oilers, one furnace man and one wiper. When coal was used five men were on watch in the fire-room, as against two when oil was used.

It is also stated that an efficiency of from 70 to 80 percent of oil fuel in California is obtained, as against 60 to 65 for the coal. A pound of California crude petroleum contains 19,000 British thermal units, while the average Pennsylvania coal contains 14,000 to 14,500 British thermal units. A pound of this oil will evaporate twice as much water as a pound of coal. The actual evaporation efficiency of a pound of oil will be in the ratio of 17 to 10.

In INTERNATIONAL MARINE ENGINEERING for April is a verification of the economy in using oil, in the description of the test of the Revenue cutter *Golden Gate*.

### DESIGN AND CONSTRUCTION OF FREIGHT STEAMSHIPS FROM THE ARCGO TRANSFERRING STANDPOINT.

H. McL. HARDING.\*

The importance of being able to increase the efficiency of transportation at steamship terminals is now being recognized by the highest executives.



FREIGHT-HANDLING MACHINERY.



ANOTHER FREIGHT HANDLER.

There are two ways in which improvements are now being made: First, in the installation of machinery in the place of manual labor, and second, in the arrangement and construction of the pier sheds. There still remains a third—namely, the design of freight steamships, so as to remove the present obstructions to quick and economical freight transference. There have recently been constructed in the United States several new steamships, exclusively for transporting freight. Although these vessels are designed for freight carrying only, little or no improvement has been made in the location, number or size of hatches, and side ports, so as to facilitate the loading and discharging the freight. Some of the newest freight steamships are no easier to load and discharge than the passenger vessels.

The following are some of the special features which hinder the rapid and economical freight transference:

The side ports are too narrow and not of sufficient height. There is a limited number of over-all hatchways, and these are generally too small. In some of the forward and aft

hatchways it is necessary to hoist from the deck level over the rail. The building of officers' quarters, kitchens, mess rooms and even store rooms, over the whole central portion of the vessel, greatly increases the difficulties of reaching the cargo between decks and renders necessary the blind hatches.

In the handling of freight it should be remembered that machinery is now supplanting manual labor, and will be exclusively employed as soon as the personal equation is supplanted. The most modern methods and the type of such mechanism should be taken into consideration when the design of new freighters is being prepared. The modern machines now being installed at many ports are overhead traveling gantry cranes which, in discharging, lift directly or vertically from the hatches. With coastwise steamers the movement of freight is not only from the hatches, but also through side ports, by manual labor. Considering the mere loading or discharging of the vessel, there would be far greater economy in hoisting the cargo through the hatches and placing it upon the side of the pier than in hand trucking it through the side ports, provided, that freight handling was considered in the designing of the ship. By the latest methods the freight can be taken from the holds to cars, to warehouses, or to any portion of remote sheds without rehandling.

Where the vessel is to carry passengers as well as freight it is necessary to more or less sacrifice freight un-

loading facilities to the accommodation of the passengers, but there may be a possibility of improvement even here. Where, however, only freight is to be transported, one of the most important things to consider is not only the economical transference of freight between the vessel and the shore, but also rapid transference. In fact, by some steamship superintendents rapidity is considered of more importance than economy. In some of the coastwise lines the charter value of a vessel is given as \$400 (£80) per day, and if such a vessel can be loaded or unloaded in one day instead of two there is a saving of \$400 (£80), and if there be a daily succession of such steamers during the course of the year the saving would be very great.

The recently-built coastwise steamship is constructed with small side ports and comparatively small hatches. On account of the design of this type of freighter there must be a great number of lost labor hours in conveying the freight to and fro between decks, the hold, and the hatchways, or the side ports. Generally at each hatchway there are twelve to fourteen men employed in placing the freight so that it

\* Terminal Engineer, 20 Broad street, New York.

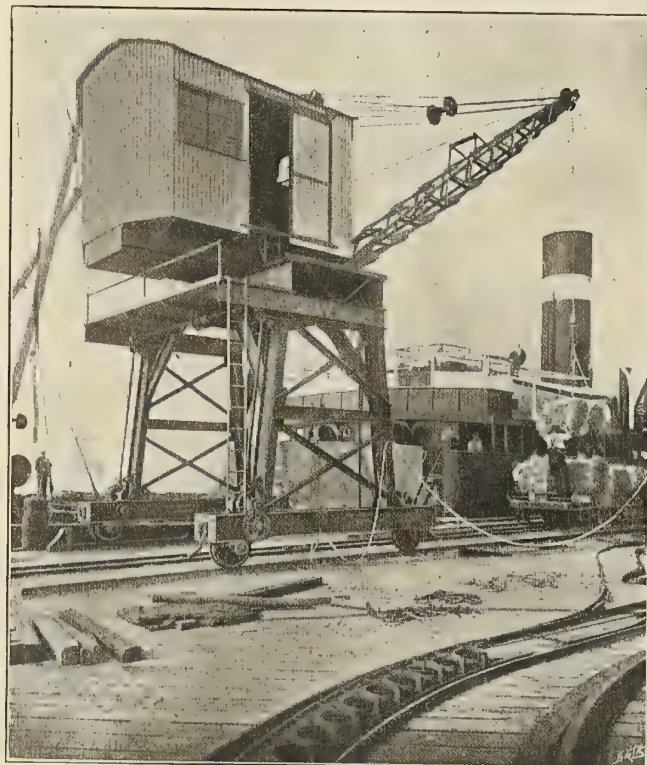
will come within reach of the ship's fall, or the hook of the overhead gantry crane, or for removing it from the hatchway. There is no doubt but that with a steamship properly designed for the quick and economical transference of freight there could be effected a saving in manual labor of 5 cents (2½ pence) per ton. On 2,000 tons this would be a saving, even when mechanical methods are employed, of \$100 (£20) for loading and \$100 (£20) for unloading, or \$200 (£40), and, in addition, less time required for the transference, which may represent a far more important economy. This saving in charter value should be 10 cents (5 pence) per ton additional. At present one of the most difficult places in which to handle freight is the lower hold. The freight is lowered into the hatchway and then it is dragged by main force from the hatchway often 40 or 50 feet. In discharging, a chain is placed around the case, the hook of the ship's fall is attached to the chain and the package is drawn over the other freight until it reaches the hatchway, where it is elevated in the usual manner. It is necessary to drag this case or package over an uneven surface, catching here and there a corner of a box and often breaking the casings and causing other damage.

Among other obstacles to freedom in freight movements in the present type of steamships are the stanchions which support the decks. In some of the newer vessels steel knees or elbows in the arch construction are used and stanchions are largely dispensed with, but even in some of the latest vessels these stanchions are still retained. Provision should be made for the stresses on decks and keelsons, as the top and bottom

composed of hatches. The quarters and accommodations of the ship's crew should be forward and aft. The large lake freighter has a length of about 600 feet, with thirty-six or so hatches, while the length of the coastwise steamer is seldom more than 400 or 500 feet. It should be possible to design a vessel of sufficient strength and stability and to arrange that the freight could be lifted vertically from the hold. While there seems to be a great diversity of opinion in regard to the possibility of building such a vessel, and making it of sufficient strength, yet from the experience obtained from the Brunswick steamships and the lake carriers it seems as though some engineer, by properly proportioning and arranging the steel structure, can produce a boat which shall, in the near future, be the accepted type for freight transportation.



FREIGHT TRANSPORTER.



TRAVELING DOCK CRANE.

members of the fore-and-aft girder. The steamships of the Brunswick Line were built on these lines and have been in operation for five or six years and no structural weaknesses have been reported. The views herewith of an ore freighter used upon the Great Lakes show the absence of deck obstructions. The upper deck is flush from forecastle, aft. The question is whether freight steamships cannot be constructed somewhat like these vessels or be a combination of the two. There is no question but that with modern freight transferring machinery a boat like the lake steamships, from which has been taken a load of 12,000 tons in about five hours, if filled with a miscellaneous cargo, could be far more quickly unloaded than any of the types seen along the Atlantic coast. The lake vessel is filled with ore, but it would be a long and difficult matter to unload even 12,000 tons of ore if the ocean type of boat were used. There were carried 13,000,000 tons of package freight in the lake boats last year.

If a freighter could be so constructed that boxes, barrels and packages of all kinds could be hoisted vertically and swung over the side without the lateral or horizontal moving between decks it would be a great improvement over the present laborious methods between decks and in the hold. In freight vessels as much of the deck as possible should be

The following data in reference to miscellaneous cargo freight and to the expense incurred for labor within the hold of the vessel will show that economy is possible in freight handling, provided the design of the vessel is changed so as to give ready access to the cargo:

#### OUTBOUND FREIGHT (Manual Labor.)

|                                                                       |              |
|-----------------------------------------------------------------------|--------------|
| Average cargo per ship.....                                           | 2,000 tons   |
| Average cost per ton handled, manual labor only, including tying..... | \$0.37 (1/6) |
| Average number of men employed.....                                   | 170          |
| Average number of men in ship (holdmen).....                          | 60           |
| Average time of loading.....                                          | 17 hours     |

#### INBOUND FREIGHT (Manual Labor.)

|                                    |              |
|------------------------------------|--------------|
| Average cargo per ship.....        | 2,000 tons   |
| Average cost, including tying..... | \$0.39 (1/7) |
| Average time discharging.....      | 17 hours     |
| Holdmen .....                      | 60           |

#### OUTBOUND FREIGHT (Machinery.)

|                                            |                     |
|--------------------------------------------|---------------------|
| Loading 2,000 tons in nine hours:          |                     |
| Total manual labor costs.....              | \$218.00 (£43 12/-) |
| Cost holdmen .....                         | \$162.00 (£32 8/-)  |
| Cost per ton loading, including tying..... | \$0.13 (6½d.)       |

#### INBOUND FREIGHT (Machinery.)

|                                                |                     |
|------------------------------------------------|---------------------|
| Discharging 2,000 tons in nine hours:          |                     |
| Total manual labor costs.....                  | \$245.00 (£49)      |
| Holdmen .....                                  | \$189.00 (£37 16/-) |
| Cost per ton discharging, including tying..... | \$0.14 (7d.)        |

It will be seen what a large proportion of the labor costs

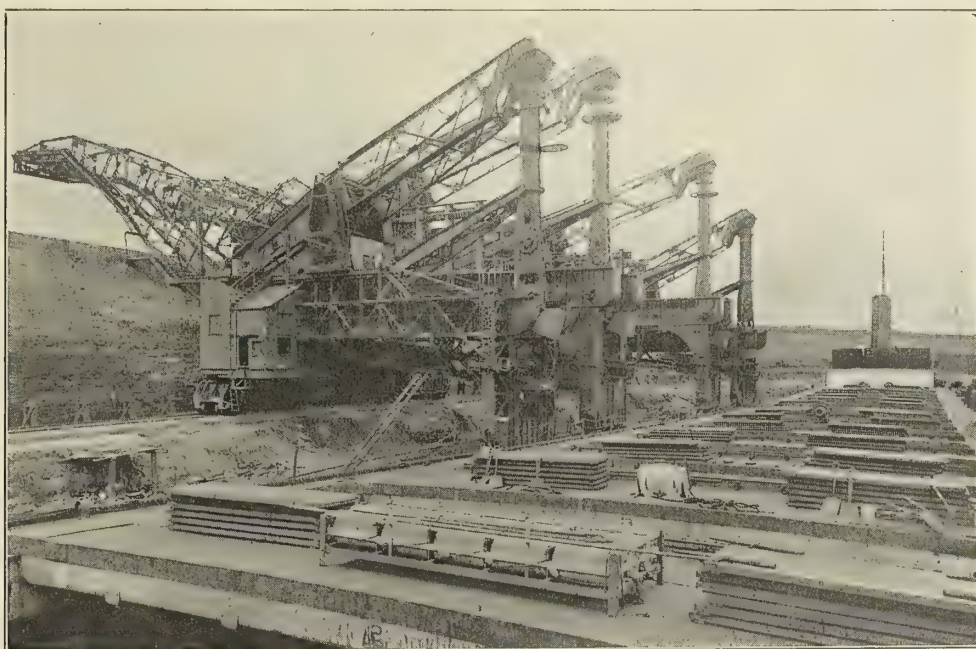
is consumed within the ship, even when mechanical methods are employed.

In loading, it is...\$162.00 (£32 8/-) of the \$218.00 (£43 12/-)  
In discharging, it is...\$189.00 (£37 16/-) of the \$245.00 (£49)

Not long since, I went over a new freight steamer with the stevedore and he was praising the new vessel, its solid construction, its lines, and many other points of excellence, but I asked him if he thought it was convenient for loading and discharging. He did not want to express an opinion, for, to use his own words, "I would be considered a knocker, and my opinion would not be considered of value by the engineers." It developed in the short conversation that he regarded the boat as most inconvenient to load and discharge on account of the small and narrow hatches, the low headroom of the side ports, and the fact that the side deck ports could not be opened down to the deck, so that the load had to be hoisted up over the rail. These and many other facts were drawn from him, and further, that he considered this new boat far inferior to the older boats in regard to the ease with which freight could be taken to or from the vessel, and he

freight handling standpoint, due provision being made for strength, stability and all other necessary conditions. It is not intended that any of these and other important features shall be sacrificed, but that they shall be retained, and, in addition, provision made for the loading and discharging of the vessel in not over half the time and at a greatly reduced expense. I fully realize that it is easier to take down from the shelf the dust-laden plans and designs of the past and copy these rather than to start afresh with new calculations, but now the impelling force is the necessity for more improvement in freight transference. If the above is true in regard to the naval architect how much more is it true in regard to the shipbuilder, who must not only evolve new plans, but consign to the waste heap forms, patterns, and possibly even machine tools?

The manager of a large steamship company who was asked why he perpetuated these obstructions to freight movements, said, "We employ and leave these matters to the shipbuilders and naval architects, and suppose there are good reasons for not making any changes." It is hoped that a discussion will



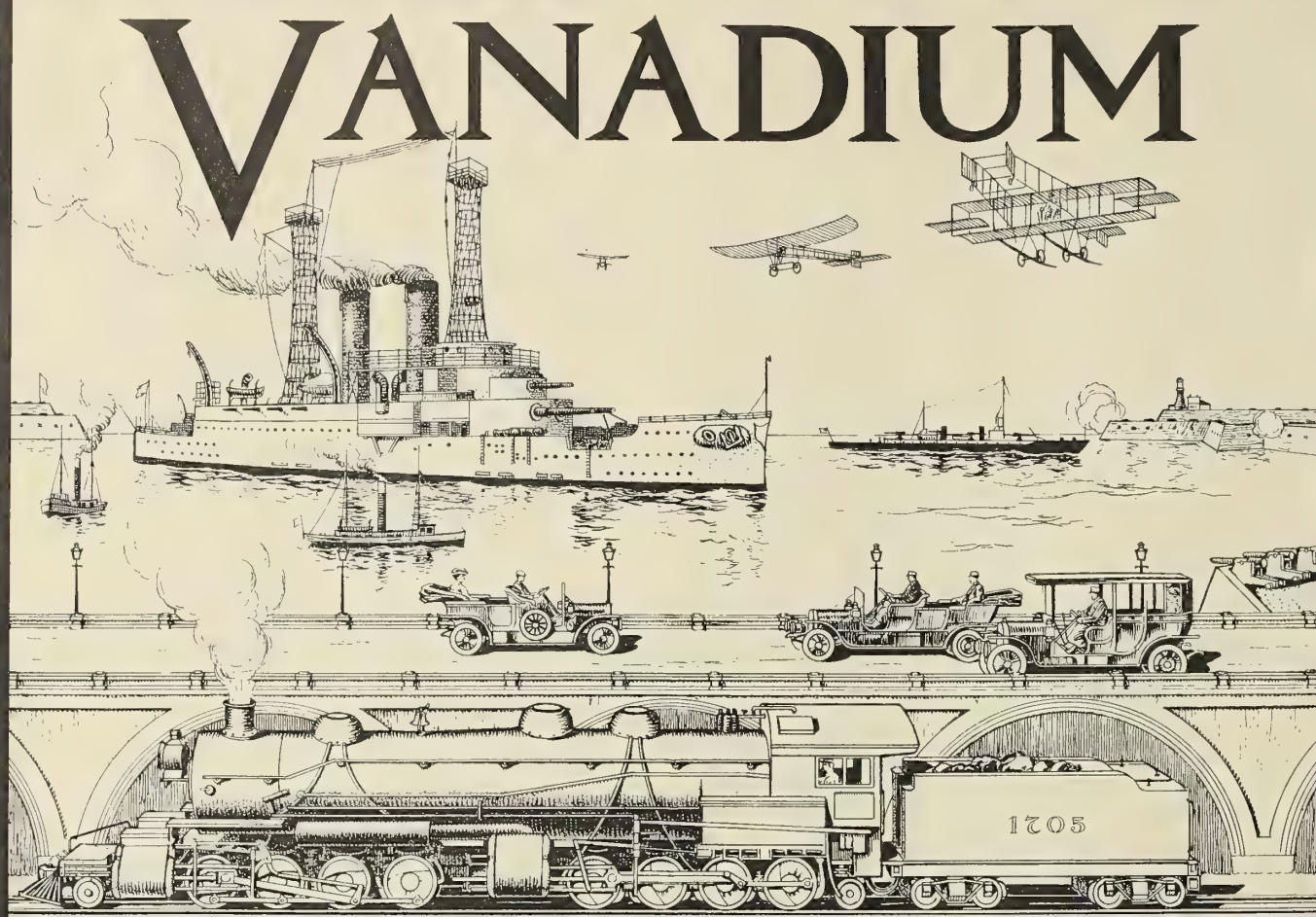
HANDLING ORE ON THE GREAT LAKES.

deplored the fact that more time would be consumed in loading and discharging.

From numerous conversations with men who have charge of important terminal work, and from a careful study of the operating condition of handling freight, it seems to me that if the naval architect or builder would spend a week by the side of the stevedore and see the exact process of handling the freight, not merely for an hour each day, but from the time the gang starts in the morning until it leaves off at night, noting carefully the difficulty in handling the different kinds of freight, such as lumber and structural steel, with a full knowledge of the unnecessarily lengthened labor hours, there is no doubt but that more attention would be paid to this important subject of miscellaneous freight transference. Comparison between some of the steamers built in the United States and those in Great Britain, especially those from Glasgow, shows that vessels can be built with very much larger hatchways, even for ocean duty, by American designers. It now remains for some naval architect to design a vessel which shall be the type for many years to come, and this vessel should be designed with reference to its use from the

be aroused and that the more progressive builders and architects will indicate how vessels can be constructed so as to help the transportation companies in this important matter of facilitating the terminal work. Herewith are some views of freight-handling machinery adapted for taking the freight directly from the hold of the vessel and placing it upon the pier floor.

A new type of steamship has lately been constructed by Messrs. Osbourne, Graham & Company, Sunderland, which is classed at Lloyd's 100-A, and is of the arch construction, with enormous hatchways. It is stated that by the redistribution of material that the longitudinal strength has been greatly increased and that the form and structure do away entirely with the usual hold-pillaring. Clear arches are given without any obstructions. Longitudinally the form is also that of an arch, and with the transverse girder, there is greatly increased handling room. This seems a move in the right direction, as not only is freedom from obstructions thus obtained, but also a clear, unrestricted vertical movement of freight, which is so essential where machinery takes the place of manual labor.



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# VANADIUM BRONZE

TO FIT ALL CONDITIONS OF MARINE SERVICE, IS HERE-WITH SHOWN. THE PHYSICAL PROPERTIES OF EACH TYPE SHOULD BE NOTED IN THE APPENDED TABLE.

- TYPE 1. For general run of castings, such as propellers, propeller struts, couplings, relief valves, shaft sleeves, thrust rings, gear pumps, hooks, gun mountings, stern bearings, etc., etc.
- TYPE 2. For marine fittings, condensers, gate valves, rocker arms, bilge pumps, binnacle stands, mast fittings, cleats, chocks, belaying pins, governors, search light stands, towing hooks, brackets, eccentrics, throttle valves, torpedo tubes, torpedo breeches, conning towers, periscopes, deck plates, etc., etc.
- TYPE 3. For engine housings, engine bedplates, air compressor bedplates, air compressor framings, hand wheels, gears, rudder bearings, stuffing boxes, windlass gears, windlass drums, bearing brasses, bushings, spiral gears, port lights, air pumps, reducing valves, etc., etc.
- TYPE 4. For whistles, radiator valves, also for forging purposes.
- TYPE 5. For plug cocks, steam traps, thermostats, etc.
- TYPE 6. For forged pump rods, bolts, valve stems, hose couplings and all kinds of fittings to be riveted. This type is also produced for rolling and drawing.
- TYPE 7. For general hardware, quadrants, railings, name plates, indicators, hatches, grease cups, oil cups, gauges, stanchions, engine telegraphs, controller fittings, etc.
- TYPE 8. For air compressor cylinders, oil pumps, injectors, exhaust headers, exhaust valve bodies, elbows, tees, water jacketed bearings, gas mufflers, hydraulic valves, hydraulic valve fittings, steam valves, etc. It is a high pressure Steam Metal.
- TYPE 9. A special metal used in ship bells, electric bells, electric gongs, fire bells and gongs, submarine signal bells, etc.
- TYPE 10. For turbine buckets, superheated steam valves, steam nozzles, pump linings, trolley wheels, circulating pumps, safety valves, journals, glands, etc.

## TESTS BY TENSION OF THE DIFFERENT TYPES OF VANADIUM BRONZE CASTINGS.

| TYPE. | TENSILE STRENGTH,<br>SQUARE INCH,<br>LBS. | ELASTIC LIMIT,<br>SQUARE INCH,<br>LBS. | ELONGATION<br>IN TWO INCHES<br>PERCENT. | REDUCTION<br>OF AREA,<br>PERCENT. | DIAMETER<br>OF<br>TEST PIECE. |
|-------|-------------------------------------------|----------------------------------------|-----------------------------------------|-----------------------------------|-------------------------------|
| 1     | 71,000                                    | 28,500                                 | 32.0                                    | 27.8                              | 1 Inch                        |
| 2     | 65,400                                    | 28,400                                 | 38.5                                    | 31.1                              | 1 Inch                        |
| 3     | 65,100                                    | 34,400                                 | 18.5                                    | 17.2                              | 1 Inch                        |
| 4     | 56,900                                    | 22,800                                 | 57.5                                    | 43.7                              | 1 Inch                        |
| 5     | 59,500                                    | 22,000                                 | 52.0                                    | 37.6                              | 1 Inch                        |
| 6     | 51,100                                    | 18,100                                 | 65.0                                    | 45.3                              | 1 Inch                        |
| 7     | 59,200                                    | 23,000                                 | 50.0                                    | 39.1                              | 1 Inch                        |
| 8     | 32,000                                    | 17,500                                 | 21.0                                    | 18.8                              | 1 Inch                        |
| 9     | 62,940                                    | 32,960                                 | 8.0                                     | 17.0                              | 1 Inch                        |
| 10    | 70,000                                    | 40,000                                 | 21.8                                    | ....                              | 1 Inch                        |

WHEN ORDERING, PLEASE SPECIFY TYPE OF VANADIUM BRONZE YOU DESIRE

## VANADIUM METALS CO.

FRICK BUILDING

PITTSBURGH, PA.

### Hudson River Boat Benjamin B. Odell.

The Harlan & Hollingsworth Corporation, Wilmington, Del., has built for the Central Hudson Steamboat Company the *Benjamin B. Odell*, which is unique in the fact that she is the first river steamer to be classed by Lloyd's Registry of Shipping and built under its direct supervision. Her dimensions are as follows: Length, 280 feet; breadth, extreme, 50 feet; depth, 16 feet 3 inches. This vessel has a speed of over 18 miles an hour against the tide on the Hudson River. She carries about 400 tons of freight. All material used in her construction is of the best, and the steel was tested to the requirements of Lloyd's.

The side of the vessel is flared out so that no overhanging guard and braces are required. This arrangement increased the strength of the vessel and makes her such that she can be used for outside service. The vessel is sub-divided by five watertight steel bulkheads, and the enclosures around the engine and boiler hatches are of steel from the main deck up through all the passenger decks. Below the main deck space is left for a freight hold forward of the boiler room, and is served by a double elevator from the main deck. The

of the vessel, and there is a long deck-house, the greater part of the fore end of which is used as an observation room. Along each side of this deck large staterooms are built, having metallic beds, washstands, hardwood floors, and two windows to each room. Two cabins on this deck are provided specially for ladies. An observation room of smaller dimensions is provided for at the after end of this house. There is ample promenading space all around outside of the house, so that the passengers can have a good view at all times. The toilet rooms for men and women are located in the center, and are lighted and ventilated by overhead skylights.

The saloon deck extends the full length of the vessel the same as the upper deck, and has a long deck house and toilet rooms of a similar nature. On this upper deck there are seven large bedrooms and parlors, some of the parlors being fitted with Pullman beds, and the bedrooms with large brass beds. There are sixty-eight staterooms in all on the vessel. At the after end of the saloon deck the dining saloon is located. It has parquetry floor. Provision is made to seat one hundred people. The position of the dining room and the large number of windows make it such that a good view can always be obtained. Adjoining the dining room and opening off it is a



NEW RIVER BOAT BENJAMIN B. ODELL.

main deck space is devoted to freight from the after passenger entrance to the bulkhead abaft the crew's entrance forward. The exterior of this freight enclosure is built of wood, and has five freight gangways on each side. Forward of the freight space in the lower hold is the crew's quarters. The steering engine is also placed here. Abaft the machinery space there is accommodation for sixty steerage passengers, while farther aft are rooms for the petty officers, also mess rooms and accommodation for the waiters. The berths and lockers in all of these spaces are of metal. These rooms are lighted by air ports and large escape ports are provided at suitable places so that escape may be had through the side of the vessel in event of fire.

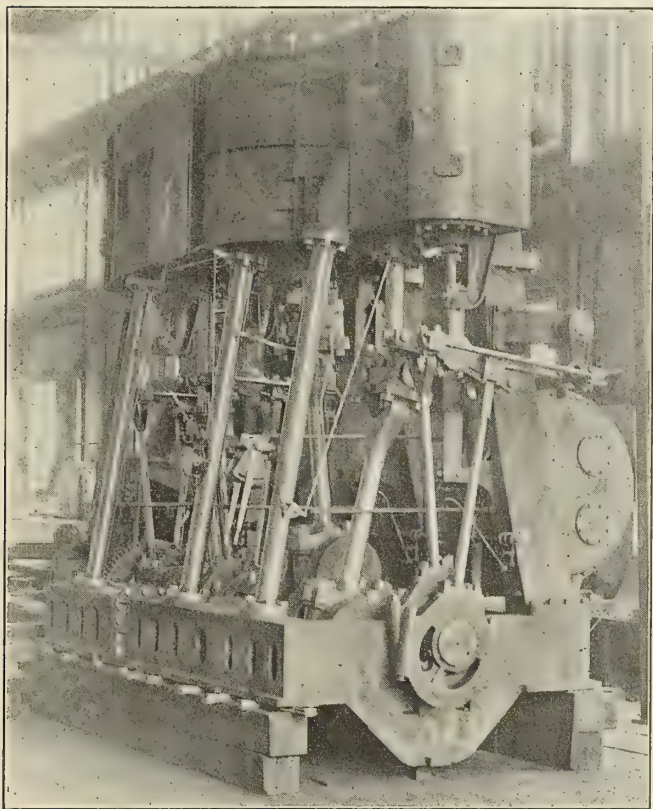
On the main deck abaft the passenger entrance is the smoking room for men and a toilet, also the purser's office, baggage room, and in the extreme after end of the vessel the kitchen, together with icebox and storeroom. Steerage passengers are permitted the use of the main deck forward of the freight space. Steam windlass and toilets are also located here. The upper deck over this freight space is extended the full length

smoking room and bar room, also the pantry. The pantry is served from the kitchen by a dumbwaiter and by stairways. The usual cooking apparatus is to be found in the kitchen and every means for rapid service is provided in the pantry.

On the hurricane deck a house is built with a large lobby having upholstered seats and carpeted floor, and forming a splendid observation room, which can be entered from the hurricane deck or by a grand stairway from the saloon deck. The pilot house, captain's and officers' rooms are all on this deck, as are also the lifeboats. The dining saloon on the saloon deck is lighted and ventilated by a dome which projects through the hurricane deck. This dome, like all of the joiner work, is supported and strengthened by steel pillars and girders in such a manner that passengers are permitted to use the top of the dome, which is fenced around by a rail. Metal stanchions are fitted around all the decks with wooden rail on top and wire netting on the side. The vessel is heated throughout by steam and an electric fire alarm system will be fitted complete by the Mohican Electric Alarm Company, Poughkeepsie, N. Y. The vessel is equipped in every way to

comply with the United States laws, and also the requirements of Lloyd's. Electric bells are fitted in the staterooms and a Rush indicator is installed in the pilot house, together with the usual tell-tale for running lights. The vessel has a powerful searchlight placed on top of the pilot house.

The vessel is propelled by a three-crank triple-expansion engine having three cylinders, high-pressure 26 inches, intermediate 41 inches, and low-pressure 68 inches diameter, the stroke being 36 inches. The cylinders are arranged with the high-pressure forward, the intermediate aft, and the low-pressure in between; high and intermediate each having one piston valve, and the low-pressure a slide valve, which is worked by the Stephenson link motion, with the usual direct-connected steam cylinder for reversing. The crank shaft is 12½ inches diameter, built up into two pieces and coupled together between the low and intermediate cylinders; the main bearings are of cast iron, five in number. The back columns



ENGINE OF THE ODELL.

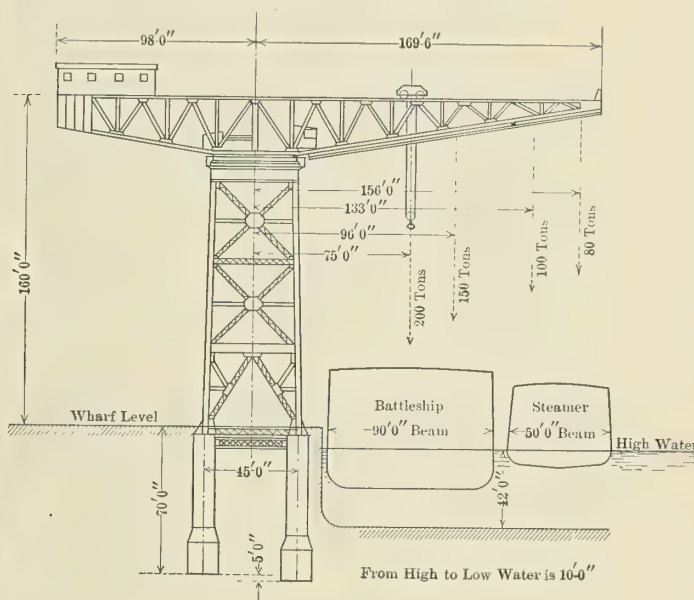
are of cast iron inverted "Y" pattern, one under each cylinder; the front columns are polished steel, three in number. The turning gear consists of a single-cylinder engine, connected by the usual worm and wheels to the crank-shaft coupling. The condenser is circular, of steel plates, containing about 3,900 square feet of surface, placed at the back of the engine. The propeller is a solid four-bladed casting, 11 feet in diameter. All pumps are independent of the main engines, several of them being in duplicate, as follows: One vertical twin-beam air pump, two vertical feed pumps, one horizontal duplex donkey and fire pump, one horizontal duplex bilge pump, one horizontal duplex salt water pump, one horizontal duplex fresh-water pump, one centrifugal circulating pump, direct connected to a single-cylinder engine for the condenser. The feed-water heater is the Reilly multi-coil, and is fitted between the feed pumps and the boilers. The steering engine is a 7 by 7 Williamson, and the engine packings by Katzenstein.

The boilers are of the cylindrical return tube type, four in number, 13 feet diameter by 11 feet 3 inches long, with a

working pressure of 180 pounds. Each boiler has three suspension-type furnaces, 3 feet 6 inches diameter, and 315 tubes, 2½ inches in diameter. The boilers are worked under forced draft, the uptakes being connected to one double stack. There are two large ventilators in the fire room and two in the engine room. On trial and in service this vessel has attained a speed of about 23 miles per hour when developing about 3,000 indicated horsepower.

### 200-Ton Cantilever Crane.

This mammoth crane has just been erected by Sir William Arrol & Co. at the Clyde shipbuilding yard of the Fairfield Company. It is built on four steel cylinders, each 15 feet in diameter, filled with cement concrete. The tower consists of four built-up columns, braced together and placed at the corners of a 45-foot square, tapering to a 40-foot square at the roller path. The horizontal, or jib head, which is at a height of 169 feet from high-water level to rail level, revolves on a circular path of live rollers, 40 feet in diameter, on top of the tower. The jib has a total length of 267 feet 6 inches and



200-TON CRANE.

revolves to any point within the area of a circle 324 feet in diameter. The test load of the crane is 250 tons and the working capacity is represented by a lift of 200 tons at a radius of 75 feet on slow gear, a lift of 100 tons at a radius of 133 feet on quick gear, and a lift of 40 tons at a radius of 162 feet on auxiliary gear. The operating speeds are: Main hoist, 200 tons at 5 feet per minute; main hoist, 100 tons at 10 feet per minute, and auxiliary hoist, 40 tons at 20 feet per minute. The maximum load of 200 tons can be lifted through a total of 170 feet, 30 feet of which is below wharf level and 140 feet above it. The speeds of the racking and slewing motions of the jib are of corresponding efficiency, viz.: 30 feet per minute for racking and one revolution in six minutes. There are three controlling brakes on the main lift—one magnetic, one mechanical and one hydraulic. The racking is done direct by motor driving all the wheels. In the machinery house at the back end of the jib there is an overhead traveler for dismantling and repairing machinery or armatures of motors. The motors employed for the lifting and other motions of the crane vary from 40 to 90 horsepower and are governed by separate controllers of the metallic type.

## PRODUCER GAS PLANT ON BARKENTINE ARCHER.

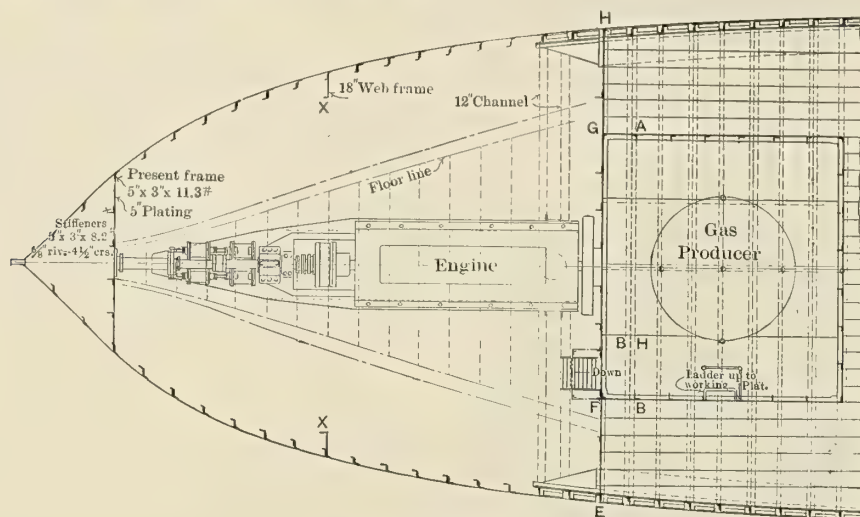
BY A. H. COX.

The Seattle Gas Engine Machinery Company is making a producer-gas installation in the barkentine *Archer*, owned and operated by the Tacoma & Roche Harbor Line Company, of Roche Harbor, Wash.

The vessel is approximately 900 tons, 180 feet in length, 32

feet beam, iron hull. The main engine is a 300-horsepower Nash engine, built by the National Meter Company, New York. It is four-cylinder type; cylinders 18 by 18, operating at a speed of 200 revolution per minute on producer gas.

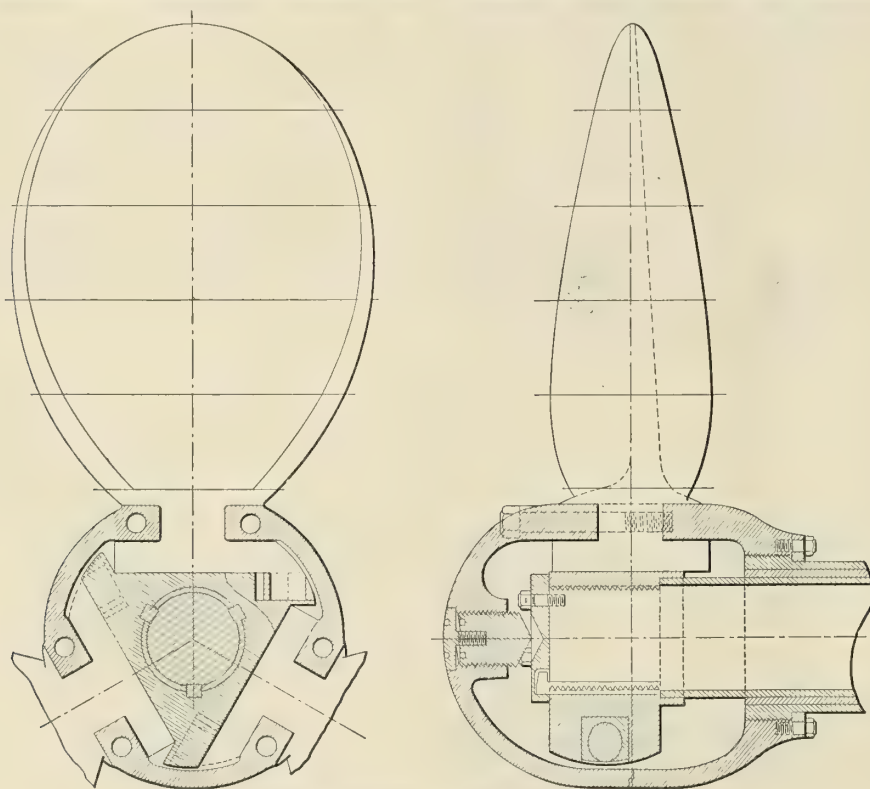
Spare's manganese bronze. It is of the feathering blade type. Reverse is accomplished by moving the blades fore and aft. The operation of clutch and reverse of propeller are accomplished by pneumatic cylinders, the reverse cylinders being controlled by oil dash-pots with a valve regulated by-pass, to render the travel of the blades smooth and uniform and prevent the back-lash when the blades go from ahead or astern position to center. The travel of the air cylinders controlling the clutch



PROPELLING PLANT ON THE ARCHER.

feet beam, iron hull. The main engine is a 300-horsepower Nash engine, built by the National Meter Company, New York. It is four-cylinder type; cylinders 18 by 18, operating at a speed of 200 revolution per minute on producer gas.

is cushioned pneumatically at the end of the stroke. The control of the pneumatic cylinders is effected by two levers similar to a street car controller, which are brought up through a column, bolted to the engine-room floor, the handles



REVERSIBLE PROPELLER ON PRODUCER GAS VESSEL.

The weight of the engine is 8,050 pounds. A 500-horsepower Akron friction clutch is mounted directly upon the transmission end of the engine shaft, which is connected to the thrust shaft. The propeller, built by L. H. Coolidge, has three blades, and is 82 inches in diameter, constructed throughout of

moving in a horizontal position and the engine speed regulation accomplished by a variable speed governor is controlled by a separate lever mounted on the engine and brought to a point in close proximity to the pneumatic control.

The tail shaft is 6 3/4 inches in diameter, and the movable

sleeve for the propeller mounted on it has an external diameter of  $7\frac{3}{4}$  inches. Over the sleeve is mounted a bronze bushing, having an external diameter of  $8\frac{3}{4}$  inches, which furnishes the bearing surface of the tail-shaft, and is intended to prevent wear on the reversing sleeve. The bearing sleeve is a bronze casting, which is removable in case of wear.

The engine room is enclosed by watertight bulkheads, the after bulkhead at frame No. 3 furnishing the support of the inboard end of the stern tube and the forward bulkhead is located at frame No. 20.

The producer is installed forward of the bulkhead, and a housing installed between frames 19 and 27 above the lower deck level. The producer was designed and built by the Schmidt Gas Power Company, and is of 400-horsepower capacity. Its dimensions are 9 feet in diameter and 10 feet in height. It is of the up-draft type, designed to handle the lowest grade of lignite, which costs less than \$1 (4s.) per ton at the mine, and varies in price delivered on the Seattle water front from \$1.70 (6/10) to \$2 (8s.) per ton. It is probable that pea size will be used mostly. The coal is fed through four hoppers on the top of producer for the purpose of getting a uniform distribution. Two gas washers are on the working platform, one being used for auxiliary, only one being operated at a time. This gas washer is one of the vital points of the producer installation, and has made the producer a success on the low-grade fuels to be used, as the washer leaves in the gas only one-seventh the impurities allowable by the American Society of Mechanical Engineers.

The coal storage space extends between the main deck and the poop deck from the sides of the producer housing to the sides of the vessel. Coal is carried from the working platform to the top of the producers. A further supply of coal can be carried between decks, over the engine, being sacked and passed forward through a hatch. Additional coal can be carried upon the decks. As hold space is valuable for cargo the designer has not installed coal bunkers of any size but has been compelled to utilize space of no value for cargo purposes.

The auxiliary equipment consists of the following: A 17-kilowatt, 110-volt, direct-current Westinghouse inter-pole generator, hung from the ceiling and belt-driven from the main engine fly-wheel. This generator is designed to operate through a variation of speed on the 6-foot engine fly-wheel from 225 revolutions per minute to 150 revolutions per minute, and maintain 110 volts. In case the engine is run at a slower speed than 150 revolutions per minute the electrical supply for the various motor-driven machines will be furnished by a Nash 12-kilowatt, direct-connected distillate engine and Sprague generator. A further auxiliary for supplying illumination for the boat and operating the wireless telegraph set is furnished by a Brush 5-kilowatt, direct-connected set, which is built by the C. A. Strelinger Company, Detroit. These three generating sets are controlled on the panel of the switchboard, allowing any two of the generators to be used simultaneously and divided in any manner desired among the various circuits. The switchboard consists of six panels of Vermont marble, each 1 foot by 5 feet, and controls all the various machines and lighting circuits on the vessel.

The compressed air for operating the pneumatic reverse and clutch, the Lukenheimer whistle and the starting of the main engine is supplied by a Blaisdell duplex 4 by 5 self-oiling enclosed compressor, gear-driven by Westinghouse motor. The air receivers for the compressor are two Blaisdell cylindrical tanks, 30 inches in diameter by 8 feet in length, designed for 150 pounds pressure. The air pressure is maintained at the desired point by means of a pressure regulator and motor starter on an individual panel. This pressure regulator is designed to start the motor when the air pressure falls to a predetermined point, and stop the motor when pressure has

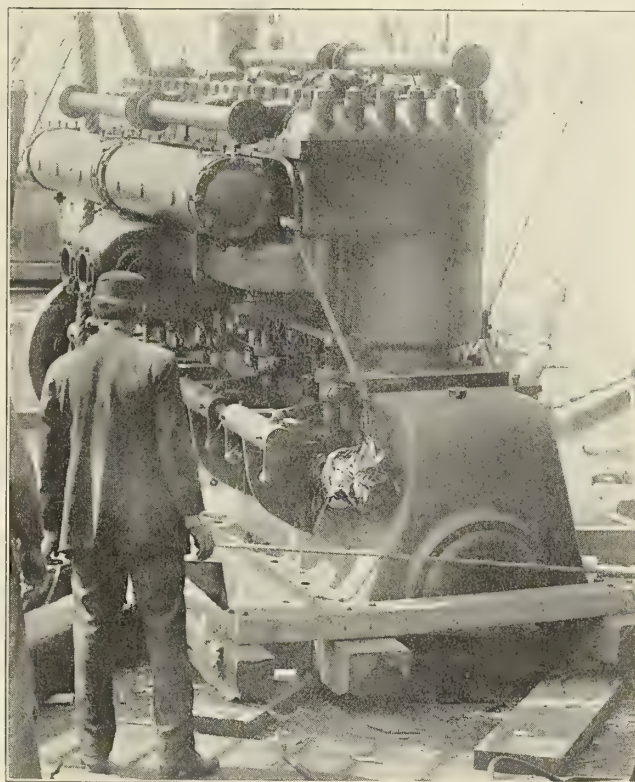
reached the desired amount, making air pressure automatic.

A motor-driven bilge pump handles bilge and also supplies water through a sea connection for washing decks and in case of fire.

A direct-connected centrifugal pump, operated by a 2-horsepower General Electric motor, furnishes the water supply for the producer-gas washer, etc., and can also be used for auxiliary engine circulation in case of accident to the main engine circulating pump.

A work bench in the engine room has all necessary tools which the space will afford for making repairs. The engine room is ventilated by natural draft ventilation, and both engine and producer rooms are further ventilated by an exhaust fan in each.

The vessel is used for carrying lime between Roche Harbor and San Francisco, and to facilitate rapid loading and dis-



300-H.P. PRODUCER GAS ENGINE.

charging a barrel elevator is installed, having a capacity of 800 barrels per hour.

In order that the owners may know at all times the location of the vessel there has been installed a 5-kilowatt wireless set of the 500-cycle, quench spark type, giving the vessel a range of about 1,000 miles at night.

It is estimated the vessel will make a round trip between Roche Harbor, Wash., and San Francisco in two and one-half weeks, including taking on and discharging freight, which will average more than twice as many trips per year as the vessel has made by sail.

Towage charges saved will amount to between \$5,000 to \$6,000 (£1,000 to £1,200) per year. It is estimated that the vessel will consume 6 tons of coal per day of continuous running, and that on an average 65 tons of coal will be required for a round trip, running on engine all the way.

This installation is the only marine producer-gas plant to our knowledge on the Pacific Coast, and we believe is the largest single-unit marine producer-gas installation in the United States to date.

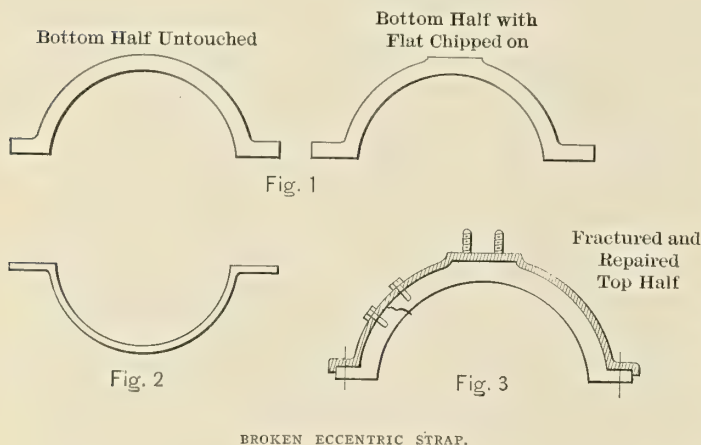
## PRACTICAL EXPERIENCES OF MARINE ENGINEERS.

## Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs.

## Broken Eccentric Strap.

Although the trouble involved in the breakdown of one of the eccentric straps of a marine engine is a very annoying thing, it is fortunate that nowadays eccentric straps are usually fitted in duplicate. That is to say, the headway strap will usually fit the sternway sheave, and in some cases the principle of duplication is carried further by providing the bottom half of each strap with a flat having tapped holes which will fit in the studs used for fixing the foot of the eccentric rod to the strap. In this way the bottom half of each strap duplicates the top half, and in the event of a broken strap in such a case it is a very simple matter to fit the bottom half of the strap into the top of the sheave until the broken strap is repaired.

If, however, as is sometimes the case, it happens that the straps are of different sizes the repairs may require a little consideration on the part of the engineers. If, for example, the headway strap is broken and none of the others will fit



the sheave, and if there are no holes for the rod foot in the bottom half of the strap, the repair, if the break is a bad one, will take some time to accomplish. The bottom half should be made to fit in its new position by chipping away a segment at the bottom in order to leave a flat suitable to take the rod foot, as shown in Fig. 1. The holes for the studs should then be marked off and drilled on the flat so formed, which is then ready for fitting. Should it be thought desirable, in order to prevent the top half so formed from jumping when running with one strap should the engine race badly, it is easy to make a plate of the form shown in Fig. 2, to be placed on the bottom, of  $\frac{1}{2}$ -inch or  $\frac{5}{8}$ -inch plate. As a rule, however, this is not required, as the weight of the valve, valve rod, eccentric rod and other gear is enough to keep the strap in its place. Another way of doing this is to use a piece of wire, winding it around one bolt in the top half of the strap round under the sheave to the corresponding bolt on the other side, and back again two or three times. The broken strap can itself be repaired, if thought necessary, as shown in Fig. 3, by means of a patch or plate suitably secured to the strap by studs.

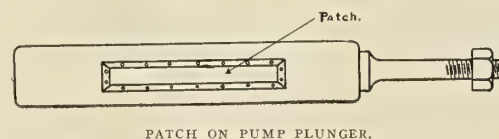
Newcastle-on-Tyne.

E. C.

## A Broken Bilge Pump Ram.

In reading the notes which now appear month by month in the INTERNATIONAL MARINE ENGINEERING, concerning sea-going experiences, I have been astonished at their number and variety. When this feature was first started I gave it a short life, expecting that one experience would soon become like another. The series, however, shows the variety that there is in a marine engineer's life. Perhaps the following account of a repair to a broken bilge pump ram may be of use to others of your readers.

On the particular boat on which this occurrence happened there was no spare ram aboard, and the one in commission, which was hollow, caved in right in the middle of its length for a length of about fourteen inches. The width of the gap was about two inches, so that the ram was not useful for much further service. It was therefore thought wise to try



to put a brass patch on the ram. While this job was going on the ballast donkey was kept going on the bilges. The bilge pump ram was got out and the engineers set to work and chipped a recess round the broken part in order to let the patch in flush with the surface of the ram. This recess was made about one inch wide. Holes were then drilled and tapped for half-inch brass studs and the patch was then fitted over them, to the curvature of the pump barrel, so as to form a smooth, flush surface. Before finally fixing the patch in position, the hollow part of the ram was filled up with Portland cement, and after putting the patch on, the studs were riveted over. This made a very neat and strong job of the repair.

Bristol.

DONALD McLAREN.

## One Way of Making a False Valve Seat for a Marine Engine.

It is common knowledge to marine engineers that with the use of the slide valve there is an unbalanced pressure on the valve and valve seat, and it is a very common occurrence for these faces to become worn down long before the cylinders themselves are worn out. In order to avoid the necessity of putting in a new and expensive cylinder before its full life has been taken, it is good practice to put a false face or seat on the valve chest. This involves a certain amount of mechanical skill, and the operation may be best described with reference to the illustrations attached.

The first thing to do is to mark off a line on each side of the ports, both for the steam and exhaust,  $\frac{1}{4}$  inch from the edges of the same, as in dotted lines shown in Fig. 1. The length of the port holes is not interfered with. The next process is to chip to the lines on each edge the ports, thus making the three ports wider than they were originally. Care should be taken to make the edges of these cuts as straight and as square as possible.

The next step is to file the old seat up level, and considerable care should be expended on this part of the job, as the

better the surface is the easier it will be to fit the false face to it. It must be remembered that when the work is finished the underside of the false seat must form a steam-tight joint with the old valve seat. After this a pattern is made of the same dimensions as the original face, with the exception that there will be two lips flanking each port on the underside, as shown in Fig. 3. An allowance must be made on the pattern for finish, so that the ports can be accurately milled and the top and bottom sides properly planed. After the casting has been made, planed and milled to the proper dimensions, the next process is to fit it into its place, the lips shown in Fig. 3 fit down into the widened portion of the old ports.

When this has been accomplished the false seat should be

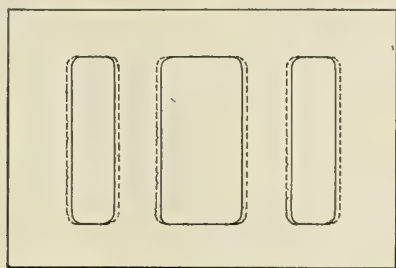


Fig. 1.

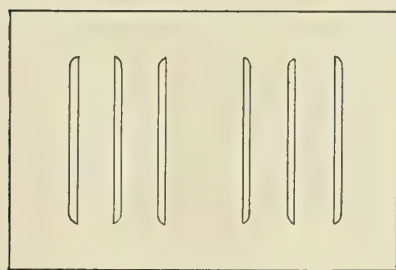
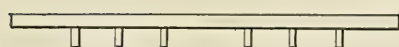


Fig. 2.

Fig. 3.  
FALSE VALVE SEATS.

drilled for  $\frac{5}{8}$ -inch screws, and they should be countersunk, so as to secure the false seat rigidly. A good, deep countersunk should be given the holes so that the heads of the screws are a little below the level of the face when it is finished. It is advisable not to have the screws too tight a fit in the thread, because it will then be possible to get a better idea what weight the mechanic is putting on the face when tightening up. After the false seat has been nicely fitted onto the old face, a very accurate face must be made in the usual way by filing and scraping, and the job should be finished by making the joint between the two surfaces with mixed boiled oil and red lead. With this job well done the life of the cylinder

Halifax.

CYLINDER.

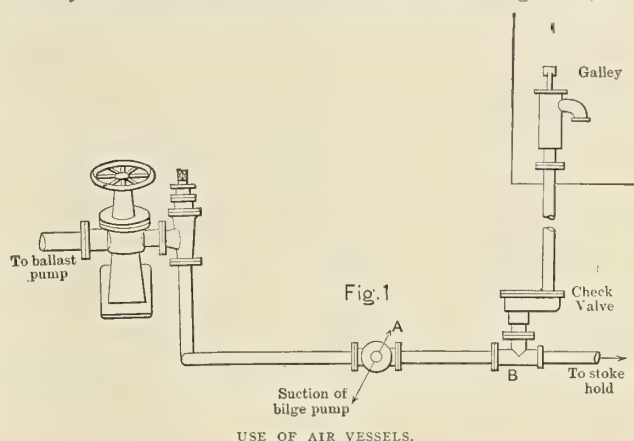
### The Use of Air Vessels.

EDITOR INTERNATIONAL MARINE ENGINEERING:

For feed, circulating and other pumps air vessels are placed on the delivery side of the pump and it is seldom wise to do without them. For circulating pumps (mostly double-acting)

the air vessel is placed on the pump or on the condenser cover, which partly forms an air vessel, and often one of the back columns serves as such. On the suction side of the pumps air vessels are seldom placed; though in most cases they are more needed there than on the delivery, especially for single-acting pumps. Feed pumps require them in nearly all cases. In single-acting pumps water is comparatively free from air. Severe noises, which are so often heard coming from pumps, may be prevented by placing air vessels on the suction side. For feed pumps large air vessels are not required, a piece of any gas pipe, not very long, is quite sufficient, but it should be placed as near the pump as possible. If a single-acting bilge pump is arranged to deliver water on deck it should be positively supplied with air vessels on the suction side.

The accompanying diagram shows the piping arrangement for sea water on a cargo boat. At *A* the pump takes water for deck service; at *B* the pipe is coupled leading to the galley at the under side of this pipe, a check valve was placed, as the galley was about 24 feet above the floor plates of the engine room, and the water was drawn by a common plunger pump. When the bilge pump was pumping to the deck a strong water-ram action was heard, and the suction pipe trembled and shook severely. It was seen that the water was flowing out of the



USE OF AIR VESSELS.

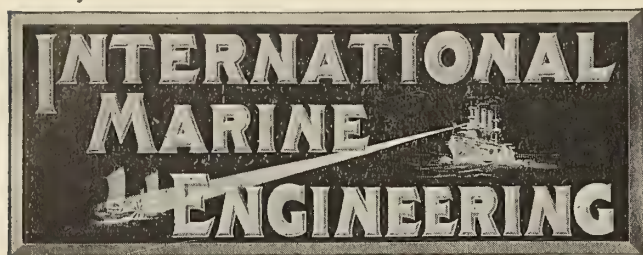
mouth of the galley pump. The cause of this was that with every stroke some of the water was forced into the pipe *B*, lifting the check valve and filling up the whole pipe. An air vessel was placed in the suction side of the bilge pump, and thereafter no trembling could be detected and the galley pump ceased to overflow.

For single-acting circulating pumps it is very dangerous to do without such vessels. Such a circulating pump was placed on the steamer *Hanover*, and no air vessel connected to it. The delivery pipe was rather small. On the trial trip the pump made considerable noise, but at sea with stormy weather the engine raced very much, loosing the bottom cover of the circulating pump and breaking it. A new one was supplied, made much stronger than the first, but on the second journey the weather again was very bad and the pump continued to make a terrible noise. The engine was slowed down as much as possible. When we made port the engineer found that the crosshead pump head had been bent so that it was not possible to run full speed. A large air vessel was placed in the suction pipe, as near the pump as possible, and thereafter never gave any trouble.

Suction and delivery air vessels behave differently when working. In suction air vessels the air is separated from the water, so that it is necessary to allow the air to escape from time to time; in delivery air vessels the reverse is the case, in which the air is absorbed by the water, so that it will be necessary to fill it up with air from time to time. This can be accomplished by the use of a pet cock.

Genoa.

D. K.



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We publish elsewhere an article on the design and construction of freight steamships, from the cargo-transferring standpoint, that needs much more than ordinary consideration. The economical handling of freight is an important, if not the most important, question before our shipbuilders to-day. There is no doubt but what there will be a steady improvement in the mechanical appliances for handling freight at steamship terminals, but these mechanical appliances can only be utilized with the best results unless naval architects and shipbuilders work in harmony with the designers of the freight-handling machinery.

Mr. Harding gives some rather startling figures which show the possibilities of great economies. Some of his figures are taken from the records of an important steamship company in New York City, and it is certainly remarkable if the cost of handling freight by machinery costs only 13 cents (6½d.) per ton, against 37 cents (1s. 6d.) per ton when manual labor is used. This enormous saving in the cost of handling freight was brought about without the vessels in question having been designed with special reference to the needs of the mechanical appliances used. If, therefore, naval architects and shipbuilders can work along the lines suggested by Mr. Harding, it seems as though there are possibilities for still greater eco-

nomies. The author discusses this important question purely from the standpoint of the practical handling of freight, and because of this his opinions are far more valuable than would be expressions from a man who has simply taken a casual glance of the requirements at steamship terminals.

It is hardly possible that the handling of freight on the seacoasts can ever be equal to the work done on the American Great Lakes, where, as stated, 12,000 tons of ore can be unloaded in about five hours; for the ore carriers are fitted for handling no other freight and do not attempt to carry ordinary package freight, as practically all the ocean and coastwise steamships do. At the same time, with the probability of saving \$100 (£20) a day on a small steamship of 2,000 tons, it behooves the naval architects and shipbuilders to work out designs that shall be marked improvements over what are now used.

A saving of a few pennies a ton in freight where ships make a round trip two or three times a month amounts to a great deal of money in the course of a year. Whether all the requirements, as stated by the author, can be worked out in practice, is a question; for, naturally, a ship that will stand the short, choppy seas of the American Great Lakes might not be staunch enough for the wrenching of the longer and heavier seas of the Atlantic. At the same time, it does seem as though there must be possibilities of improvements over present designs, so that the naval architect and the shipbuilder can deliver to the handler of freight, or, in other words, the steamship owners, vessels that shall come close to their requirements.

We hope our readers will give this paper careful consideration and send us suggestions that may meet as fully as possible the conditions stated in the paper.

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Elsewhere in this issue we describe three remarkable vessels—the huge *Olympic*, of the White Star Line; the coming gigantic Cunader *Aquitania* and the American-built yacht *Sovereign*, with a speed of 35 miles per hour. It would seem that these vessels would make us pause and consider the possible limitations in naval architecture and marine engineering; but, then, why pause? as even now there come to our ears reports that these two colossal ships are to be surpassed by a German product in the very near future. Cost seems to have become quite a secondary consideration to those interested in the great trans-Atlantic fleets, for the coming Cunarder will cost ten times what the huge “ocean greyhound” of twenty years ago cost.

These three vessels represent a complete turbine outfit, a combination of turbine and reciprocating engine, and the reciprocating engine. Speed in the case of the yacht is merely a matter of pride and a desire to be at the head—a most laudable and satisfactory state of mind to have a yachtsman in when he comes to the builder; but, on the other hand, the two great vessels for trans-Atlantic use are purely commercial.

THE MARINE STEAM ENGINE INDICATOR—XXI.<sup>1</sup>BY LIEUT. CHARLES S. ROOT, U. S. R. C. S.<sup>2</sup>

## THE COMPRESSION LINE.

At *FA* of Fig. 95<sup>3</sup> is the compression line. This line indicates the rise in pressure due to the closure of the exhaust port before the piston reaches the end of its stroke. Generally speaking, compression is imposed on us by the limitations of the valve gear which we use in marine practice. A certain amount of compression does, without doubt, help the mechanical efficiency of the engine as a machine, but it cannot be stated with equal positiveness that it increases the thermodynamic efficiency. The mechanical efficiency is increased because compression absorbs work which would otherwise be expended in producing a heavy pressure on the crank pin and main bearings with little turning effect, and gives it out again when conditions are more favorable.

When the crank pin is on the center, there is, necessarily, a certain amount of space between the piston and cylinder cover or bottom, which prudence requires us to leave on account of roughness of castings and wear of bearings and pins, and in addition to this there is the volume of the ports to the working faces of the valve or valves. The sum of these volumes is the *volumetric clearance*, and when clearance is referred to in speaking of indicator diagrams this volumetric clearance is always to be understood. In the most economical and efficient engines the clearance is generally reduced to a minimum, and more "gray matter" has probably been expended on this feature of engine design than on any other.

With the engine on the center, and before the commencement of the stroke, the clearance must be filled with live steam to boiler pressure if the piston is to begin its journey under proper conditions. If the steam is completely exhausted by the end of the return stroke the clearance steam becomes nearly a total loss, its only effect on the diagram being to raise the expansion line a little and thus slightly increase the area of the card. Under this condition the larger the clearance volume the greater will be the quantity of steam required per stroke. If the exhaust port is closed before the end of the stroke a certain amount of steam will be imprisoned in the cylinder and compressed by the advancing piston, and the indicator pencil will describe, approximately, an hyperbolic curve. The curve, theoretically, will resemble an expansion line, with the difference that the scribing point of the instrument will pass over the line from a lower to a higher pressure. Whatever was said in former chapters<sup>4</sup> relative to plotting or computing points on the expansion line will apply to the compression line also. A little thought will show that if the exhaust port be closed at just the right point the clearance steam will be compressed to initial pressure, and when the valve opens for admission the clearance space will already be filled with steam made hot by the mechanical work which has been expended in compressing it. Under this condition it is reasonable to suppose that the amount of clearance will have no effect on the steam used per stroke if expansion is complete,<sup>5</sup> as shown at *II*, Fig. 105.<sup>6</sup>

With this amount of compression and expansion we have what amounts to a permanent cushion or spring, which is alternately compressed and expanded without gain or loss of work, because whatever is absorbed in compressing the clearance steam is returned to the mechanism when it expands and the working steam only will enter and leave. If the expansion

is not quite complete<sup>7</sup> it will be necessary to so adjust the compression that the ratio of compression will equal the ratio of expansion if we are, theoretically, to annul the detrimental effect of clearance by means of compression. In other words, if we let *c* equal the volume of the clearance space *k*, the volume of the cylinder to the point of compression, including clearance *i*, the volume of the cylinder to cut-off, plus clearance and *f*, the whole volume of the cylinder, the following proportion will have to exist—*c : k :: i : f*.

Dr. Zeuner stated the principal part of this theory very concisely when he wrote: "If the laws of expansion and compression are the same, with a complete expansion a complete compression will annul the detrimental effect of clearance."

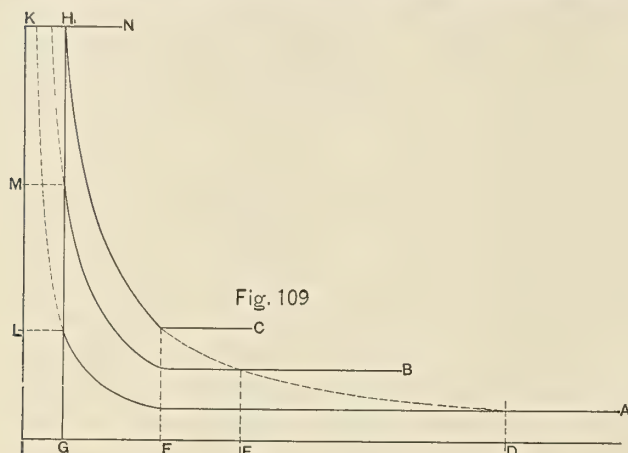
Simple and beautiful as this theory seems to be all attempts which have been made to prove experimentally that compression to initial pressure does annul the effect of clearance have resulted in showing quite the reverse in most instances. Prof. V. Dwelshauvers-Dery has, quite recently, at the University of Liège, made some very exhaustive experiments relative to the effects of compression on economy, and it is believed that his investigations have thrown some new light on the subject.<sup>8</sup> The matter will be more fully discussed under the head of economy. With regard to clearance and compression, Prof. R. C. Carpenter says:<sup>9</sup> "A study of the structure of engines which have produced the best record for steam consumption between given ranges of pressure or temperature rather leads one to believe that when noted builders desire especially high economy they do not depend upon neutralizing the effect of the clearance spaces by compressing into them steam at any sensible degree of compression. On the other hand, they apparently strive to produce highly efficient engines by reducing the clearance spaces as much as possible. A study of the diagrams which were obtained from high-duty pumping engines, such as those at Milwaukee, Louisville or Boston, show that the builders expected to get rid of the detrimental effects of clearance by eliminating as far as possible the clearance space itself. Bearing on this subject, I remember a conversation which I had some years ago with the late Mr. Edwin Reynolds, who was perhaps the greatest designer of high-duty engines this country ever produced. Mr. Reynolds told me that in accordance with his experience it was necessary to make the clearance spaces as small as possible, and operate his engines with the least possible compression in order to get the best economy. He stated that he wanted the corners of his indicator diagram corresponding to the end of the exhaust stroke as nearly as possible a right angle."

One would be rash indeed to make the positive statement that compression is absolutely detrimental to economy, but the majority of experiments which have been carefully made seem to indicate—and the opinion is becoming general among engineers—that we should compress enough to produce smooth running and no more. An interesting and typical example of actual results obtained from compression experiments is shown in Fig. 108. This diagram<sup>10</sup> shows results which were obtained from the high-pressure cylinder of the triple-expansion experimental engine at Cornell University, and was worked up by Mr. T. B. Hyde. The ordinates of the diagram give the steam consumption per indicated horsepower per hour, and the abscissa the ratio of the pressure at the end of compression as compared with the initial pressure.

The actual shape of the compression line depends on the point of exhaust closure, the counter pressure, the clearance volume and the state of the piston and valves as to tightness. Refer to Fig. 109. Let *A*, *B* and *C* represent counter pressures, *G H* the position of the surface of the piston at the

<sup>1</sup> Continued from page 161, April issue.<sup>2</sup> Copyright, 1911, by Charles S. Root.<sup>3</sup> See the September, 1910, issue.<sup>4</sup> January and February, 1911.<sup>5</sup> That is, if the expansion is carried down to the counter pressure line.<sup>6</sup> March, 1911, issue.<sup>7</sup> That is, compressed to initial pressure.<sup>8</sup> See *Power*, New York, Vols. 32 and 33.<sup>9</sup> *Sibley Journal of Engineering*, Vol. 25, No. 3.<sup>10</sup> *Sibley Journal of Engineering*, Vol. 25, No. 3.

end of the stroke,  $I K$  the clearance or line of zero volume,  $I D$  the line of zero pressure, and  $K N$  the initial pressure. The change in final compression pressure, due to a change in counter pressure, is shown as follows: With counter pressure  $A$  and exhaust closure at  $F$  the compression pressure will rise to  $L$ , with counter pressure  $B$  it will rise to  $M$ , and with a



counter pressure equal to  $C$  complete compression will result. Compression to initial pressure will also result if we close the exhaust at  $E$  when the back pressure is  $B$  and at  $D$  with a back pressure equal to  $A$ .

The change in compression, due to a change in clearance,

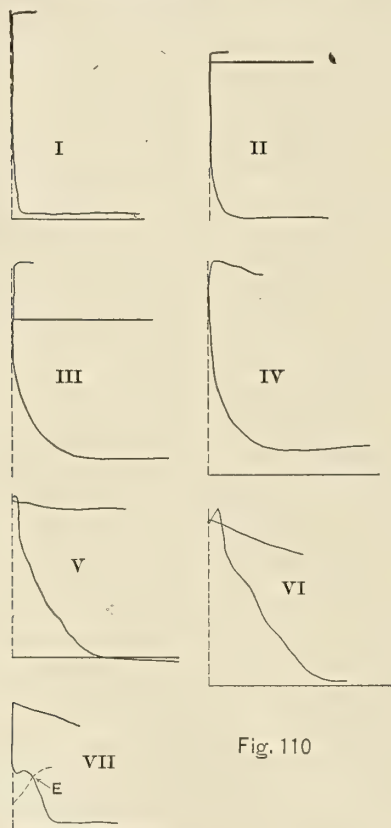
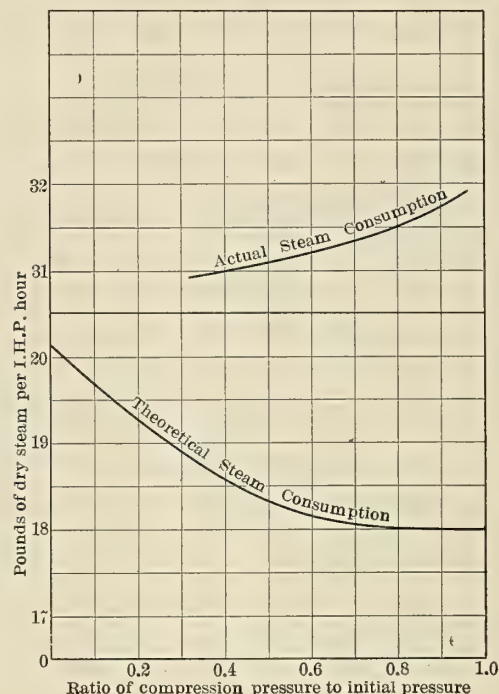


Fig. 110

will be readily seen by drawing lines parallel to  $G H$  at different distances from  $I K$ . We now come to consider some forms of the curve as found in actual practice. At  $I$ , Fig. 110, is shown a portion of a diagram from the 53-inch M. P. cylinder of a high-duty pumping engine. This compression line and the ones shown at  $I I$  and  $I I I$  represent the standard practice of the builders of these machines, in which economy of steam is one of the prime considerations. The curve shown at  $I$  is from the most modern one of the

three. These curves round up nicely to meet the admission line, as does that of  $I V$ , which was taken from a marine engine. The diagram at  $V$  is from the M. P. cylinder of a marine engine, and shows rather too much com-



pression even for a high-speed engine. At  $V I$  we have excessive compression. A most interesting card is shown at  $V I I$ . This diagram was taken from an engine whose piston was known to be leaking badly. The line rises abruptly at exhaust closure, caused by steam blowing through from the other side, where the pressure is higher. At  $E$  the pressure is equal on both sides of the piston, the leak stops and then reverses. As the piston approaches the center its motion becomes slower and slower, and the volume of steam inclosed smaller and smaller. The volume of the leak finally exceeds the volume generated by the advancing piston, the pressure falls and the "hook" is formed. In this connection it should be noted that a hook in the compression is one of the best indications of a leak to be found on the diagram. When a hook is seen above the middle of the diagram height it is not necessarily an indication of leakage, but is due in a great many cases, especially in small, slow-running engines, to condensation, brought about by the great difference in temperature between the steam and cylinder walls, which causes a rapid flow of heat to the inclosing metal.

[Owing to the absence of the author on sea duty further chapters will be suspended for a few months.—Ed.]

## PERSONAL.

THE death is announced of Mr. Alexander E. Brown, president of the Brown Hoisting Machinery Company, of Cleveland, Ohio, which was not unexpected. He was stricken a few months ago with paralysis.

MR. EADS JOHNSON, who has been well known in New York for many years in connection with marine work, has opened offices at 30 Church street, New York, as consulting marine engineer, surveys, superintendence and estimates.

MR. HENRY R. COBLEIGH has resigned as mechanical editor of *The Iron Age*, which position he has held for the last seven years, to take charge of the advertising and publicity of

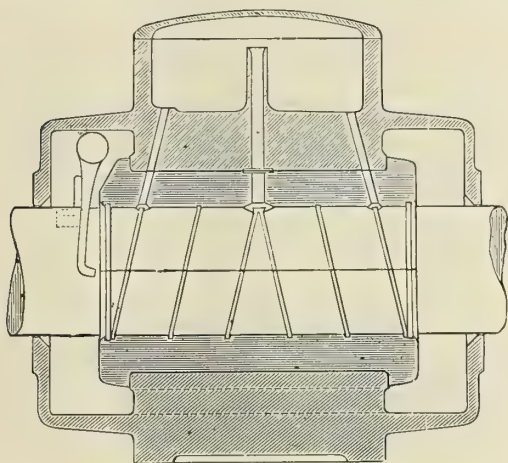
the International Steam Pump Company, No. 115 Broadway, New York City.

MR. HERMAN WINTER, after twenty-seven years of active service with the North German Lloyd Line, has resigned and associated himself with the Cunard Line.

That over one-fifth of the total British steam tonnage afloat and 25 percent of the total number of British steam vessels above 5,000 tons are owned in the port of Liverpool, was among the interesting statistics appearing in the annual report of the Liverpool Steamship Owners' Association. It appears that the association at the end of 1910 owned 3,986,369 tons of steam shipping, which is upward of 22 percent of the total British steam shipping.

#### Holtrop Automatic Lubricator.

In the Holtrop automatic lubricator there is an oil hole at both ends of the bearing with right and left-hand threads, or spirals, cut in the shaft. The right and left-hand spirals meet in the middle, and when the shaft is revolving the oil is screwed by adhesion to the shaft's surface along the grooves to the middle and forced up through the center tube back into the oil box, thus making a continuous and automatic flow of oil around the bearing. This lubricator is designed to take advantage of the adhesive qualities of the shaft's surface, from



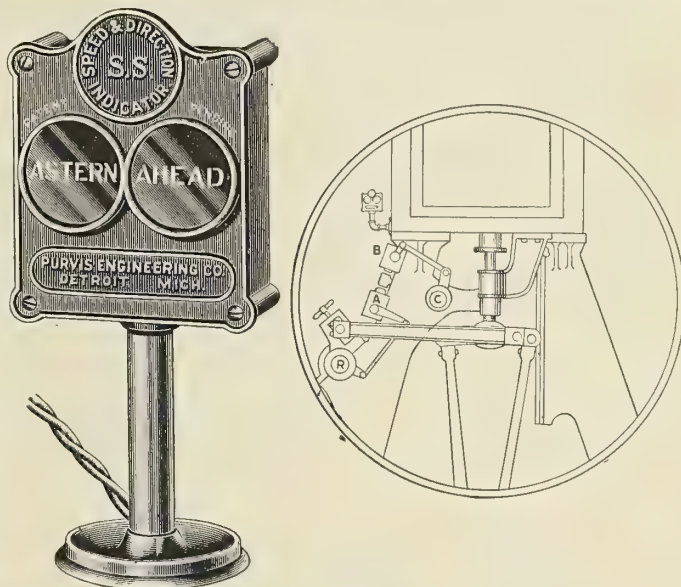
which there is no tendency on the part of the oil to escape. When the engine is reversed, or stopped, it is desirable to shut off the supply of oil, otherwise it would be wasted. One of the chief features claimed for this invention is that in a given period about 100 times the quantity of oil circulates through the bearing than would be the case with the old style of lubrication.

These lubricators are adapted to all the moving parts on engines. It is believed that a saving of from 50 to 75 percent in oil can be made by the use of this device. It is already in use on a number of seagoing vessels. More detailed particulars can be had from L. Katzenstein & Company, 359 West street, New York, who have the sole rights for the United States.

#### Purvis Speed and Direction Indicator.

The Purvis steamship speed and direction indicator, made by the Purvis Engineering Company, Detroit, Mich., is an apparatus which shows night or day in a visual manner every stroke of the engine. When going astern the left-hand disc

shows a red, and while going ahead the right-hand disc shows green, an arrangement which corresponds with the port and starboard lights. The moment the link goes over the fact is shown on the indicator; if the signal is "astern" the red light flashes on the dial before the engine starts, or if "ahead" is



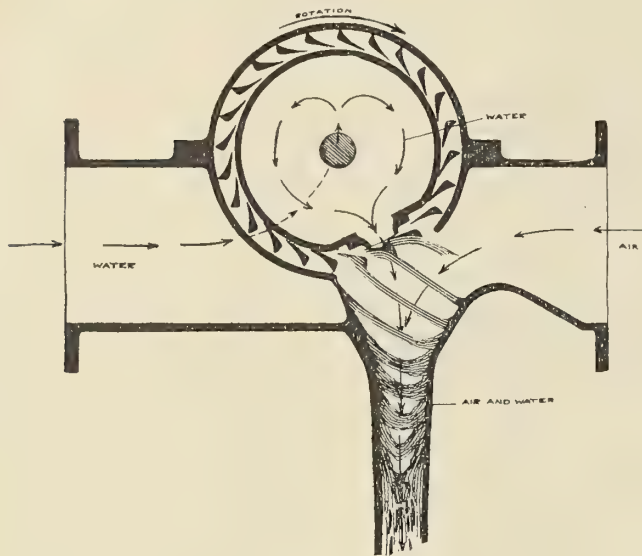
ordered the green light shows. The connections are electric. Fig. 1 shows how very simply they are made. Here the reverse switch *A* is connected with the reverse shaft *R*, while *B* is the flashing switch connected with the rod to the valve stem rock shaft *C*, the contact being made by the regular movement of the working parts, and transmitted by a three-wire cable to the indicator Fig. 2 in the pilot house or to any other station on the ship. If desired several indicators can be set up in various parts of the ship.

#### The Marine Type Leblanc Air Pump.

For marine work in general and for naval installations in particular, there is a need for high vacuum efficiency, together with economy in steam, lightness and compactness. The Leblanc air pump was designed to fulfill these requirements. In this air pump, air is drawn from the condenser, and water from the sea by the air pump, which discharges a mixture of the air and water back to the sea. Sea water is the medium used for withdrawing the air. The fresh water condensed from the steam entering the condenser does not enter the air pump, but is withdrawn separately by the hot-well pump. The air pump consists of a rotor, which revolves in an annular space between the water chamber and the casing. The water chamber is supplied through the suction pipe which is connected with the sea. On one side of the water chamber there is a nozzle which directs the water against the blades of the rotor, which are so designed that the rapid movement of the blades across the stream of water flowing from the nozzle slices off layers from the stream and projects them with considerable force into the nozzle of the discharge pipe. These layers form a continuous series of water pistons, which enter the discharge nozzle with sufficient velocity to pass out through it and the discharge pipe to the sea, overcoming the resistance due to the presence of the atmosphere and of the water.

The governor is of the centrifugal type and operates the throttling valve directly through levers. To allow for variations of steam pressure and for the operation of the governor,

the nozzle is designed for a working pressure of about seven-tenths of the main working pressure, so that a constant speed will be maintained under all conditions. These pumps are

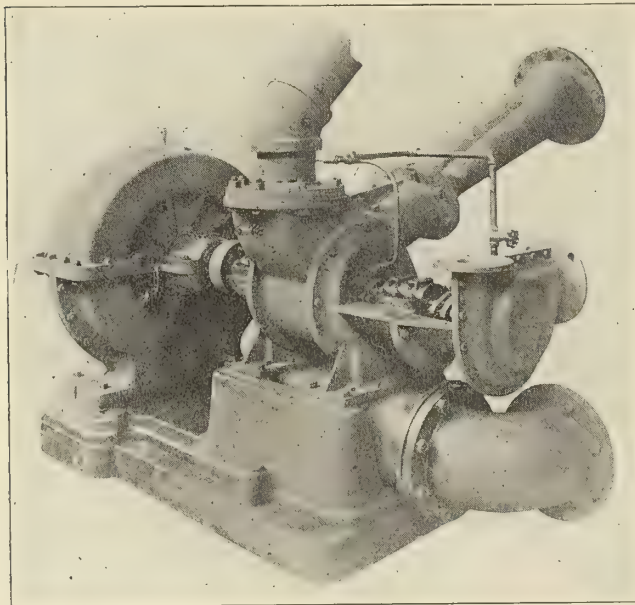


AIR PUMP ROTOR.

manufactured by the Westinghouse Machine Company, Pittsburgh, Pa.

#### Hopkinson-Ferranti Patent Stop Valve.

The use of superheated steam is demanding a valve of special design to meet the conditions of rapid changes in temperature and often increased pressure. The Hopkinson-Ferranti valve designers had a thorough knowledge of the



LEBLANC AIR PUMP.

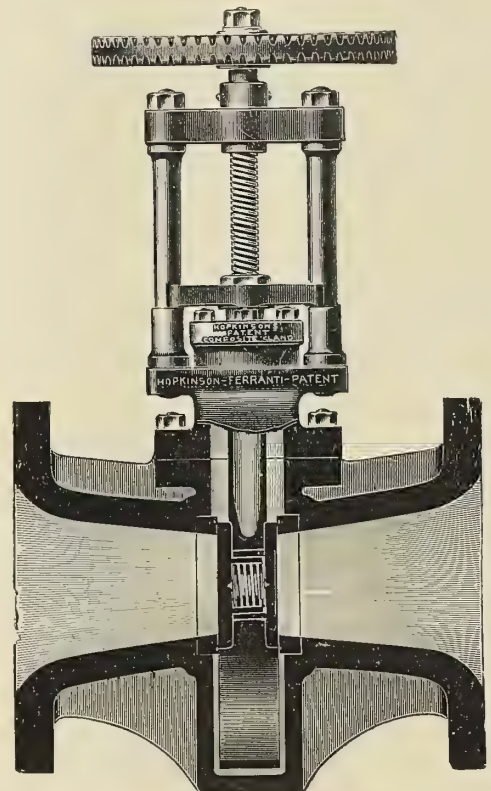
requirements to meet this want, and its construction is shown by the illustration herewith.

There are no cast iron internal fittings; when the valve is fitted in the usual upright position there are no horizontal surfaces to catch deposits or fragments which scour and damage

the seats. The discs forming the valves are free to turn on their axes in opening and closing, and its opening is gradual, thus preventing a sudden flow or rush of steam, as in ordinary valves. The Hopkinson-Ferranti valves are smaller than the ordinary valves and are opened more easily and the seats are sheltered from the flow of steam. A special material, called "Platnam metal," is used in these valves and it is claimed to be five times harder than hard cast brass. These valves are manufactured by J. Hopkinson & Co., Ltd., Huddersfield.

#### Inglisbee Coaling Outfit.

Coaling ship is at all times disagreeable, and an expensive operation, and to lessen in any way either the labor or expense

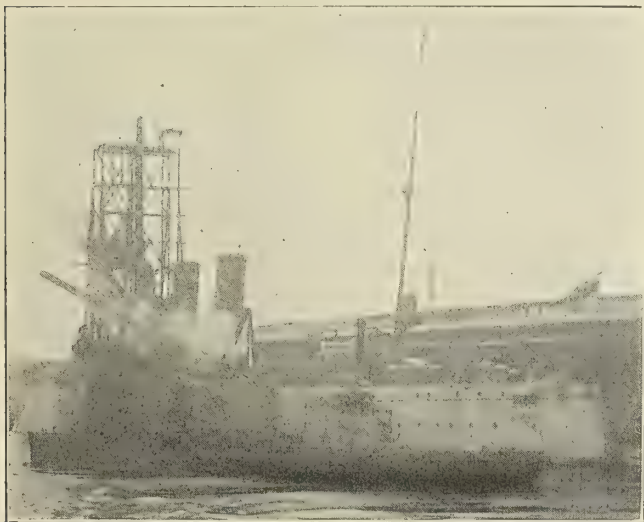


HOPKINSON-FERRANTI STOP VALVE.

is a distinct gain for all. This condition was thoroughly appreciated some time ago by Mr. William J. Inglisbee, who formed a connection with the Universal Engineering Company, of New Orleans, with the result that what they call his "steamship collier" has been brought out. Three of these colliers have been built for the Monongahela River Consolidated Coal & Coke Company, of Pittsburgh, Pa. The system is, briefly, a floating elevator which receives the coal and distributes it by gravity to the various coal hatches of the ship, but it also weighs the coal as it is delivered. On a barge is mounted a McMyler revolving crane operating a clam shell bucket which takes the coal from a lighter alongside, lifts it to the desired height and deposits it in a hopper, from which it runs by gravity to an elevator car. This car, in turn, rests on a scale, and the weigher, handling a steam cylinder which controls the outlet or door of the hopper, weighs a fixed amount for each charge. He becomes so skilled that he can bring the beam to a positive balance for each load.

As soon as the coal is weighed a signal is given by the weight master and the elevator-car with its load is raised, and

when it reaches a certain position the car door is automatically tripped by engaging with a "kicker" and the coal is delivered into a second hopper, from which lead various chutes guiding the coal to the ship's bunkers. The hoisting engines on these elevators are double, 10 inches by 12 inches, fitted with three drums, one for raising and lowering the elevator frame, another for raising and lowering the elevator car, and a third

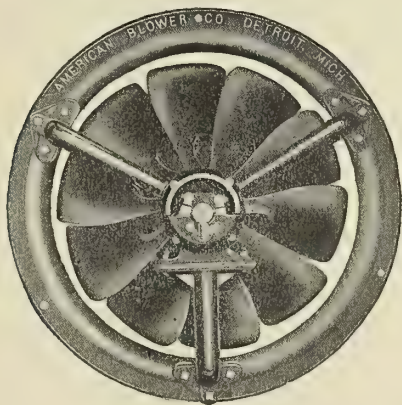


STEAMSHIP COALING OUTFIT.

for handling the chutes. In building the elevator frame steel is used, but the hull is of wood. While this description may give the impression that the operations are complicated and slow, it is remarkable how quick coal can be handled by this system.

### The Ventura Fan.

A disc fan brought out by the American Blower Company, of Detroit, called the "Ventura" is claimed to have an efficiency of 64 percent, which is about 40 percent better than the ordinary design of disc fans. The "Ventura" fan runs at speeds as high as any other fan of the disc type, if not higher; has



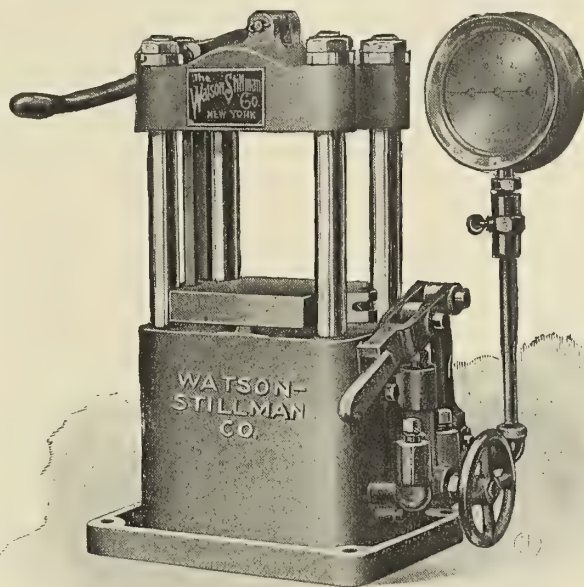
THE VENTURA FAN.

remarkable capacity to overcome resistances, and throws an air current straight ahead. In fact, the air as it leaves the fan has a tendency to bend inward for a considerable distance before it begins to expand. This is contrary to the action of any other disc fan on the market. To illustrate this feature, one

of these fans can be set 16 inches away from a hole in a box and discharge more air on the other side of the opening than the fan itself handles, due to the siphon action of the air as it passes through the opening drawing in air along the face of the box.

### A Handy Hydraulic Press.

The small hydraulic press which we illustrate was designed by the Watson-Stillman Company, New York, for laboratory work and for crushing specimens of building material, but has proven even more useful in machine shops, where small parts are press fitted, or where a high pressure must be brought to bear on any small article, whether for bending, straightening or flattening. It can also be applied to an endless number of odd jobs about any shop. The convenient size permits this press to be mounted on a light truck and hauled from place to place, and the operation is quick and easy. Quick movement of the ram is facilitated by the lever and connecting links shown at the left. The handle at the right on



WATSON-STILLMAN HYDRAULIC PRESS.

the extension-lever socket will operate the pump easily where only light pressures are required, and by applying the extension lever the press will develop a pressure of 30 tons. The platen area is 8 inches square, the platens are 8 inches apart at maximum opening, the ram movement 4 inches. The base is 12 inches by 16 inches, and the height of the press over all is 27 inches. The main cylinder is a steel forging, machined to fit perfectly into the reservoir, and the pump cylinder is of bronze. This press is designed to withstand severe service and is ideal for small work requiring high pressures.

The sixteenth annual banquet of the Marine Engineers' Beneficial Association, No 33 of New York, held on the evening of Tuesday, May 16, was one of the most successful and largely attended gatherings of the association ever held.

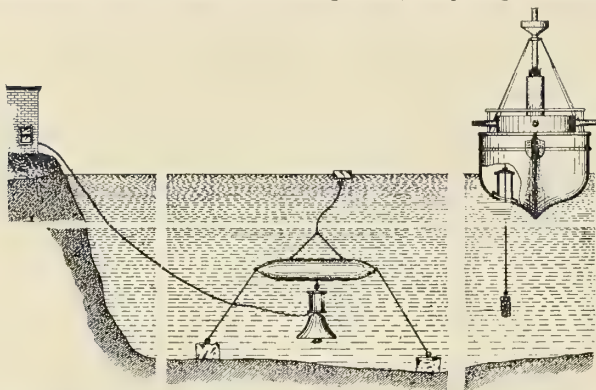
## SELECTED MARINE PATENTS.

*The publication in this column of a patent specification does not necessarily imply editorial commendation.*

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

989,250. TRANSMISSION OF SOUND. DELIA M. GRAY, OF HIGHLAND PARK, ILL., EXECUTRIX, ASSIGNOR TO SUBMARINE SIGNAL COMPANY.

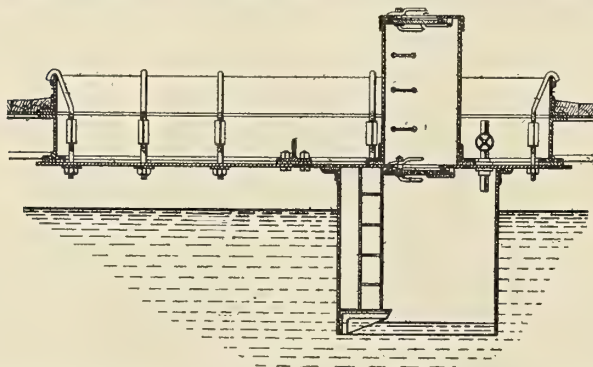
In a system for the transmission of sound, a means for producing sound waves and a means for receiving sound, comprising a number of



independent submerged sound receivers adapted to receive impulses from different parts of the same sound wave, and a sound-transmitting device for each receiver adapted to transmit the sound impulses from the receivers to a focuser or combiner, and said sound focuser or combiner.

988,614. AIR-LOCK. WILLIAM WALLACE WOTHERSPOON, OF NEW YORK.

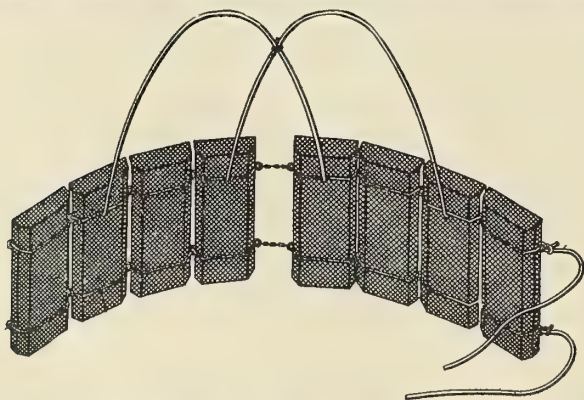
In combination with a ship's hold provided with a hatchway, a cover-plate adapted to substantially close the hatchway and provided with an



opening, a safety chamber sustained by the cover-plate and surrounding said opening, and an air-lock communicating with said safety chamber.

989,172. LIFE-PRESERVER. CHARLES R. McCOTTER, OF JACKSONVILLE, FLA.

In a life-preserver, the combination with a plurality of separate cork blocks, of wire netting closely fitting and surrounding each of said blocks separately, separate wire bands surrounding said blocks near the bottom

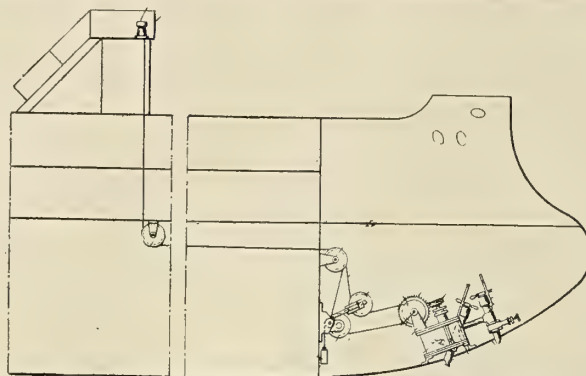


and near the top, metal rings flexibly joining the bands of adjacent blocks, and flexible wire bands for securing the said series of blocks to the body of a person.

988,832. APPARATUS FOR INDICATING THE SPEED OF SHIPS. RICHARD STARR, OF THE UNITED STATES NAVY.

The combination with a ship having an upwardly-inclined bow, of an apparatus located in said bow for indicating the speed of the ship, including indicating means, a motor operating said indicating means, means

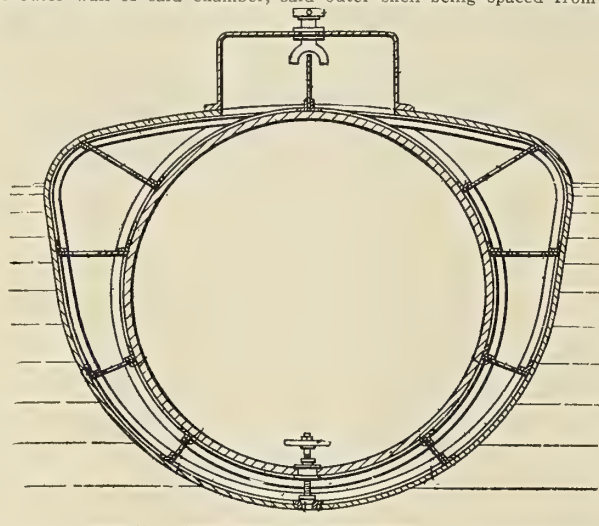
for admitting water to said motor as the ship moves forwardly, including inlet and outlet pipes adapted to be pushed down through the bottom of the ship and connections between said pipes and said motor, said inlet



pipe having its receiving end beveled and said outlet pipe having its discharge end beveled.

988,632. SUBMARINE BOAT. RAYMOND D'EQUEVILLE, OF KIEL, GERMANY.

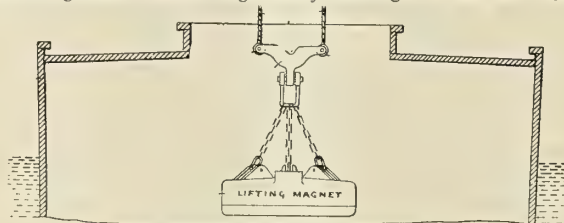
A submarine boat provided with a storage chamber comprising the hull of the boat as the inner wall of said chamber, and an outer shell as the outer wall of said chamber, said outer shell being spaced from the



sides and beneath the hull and having the top wall thereof lying substantially beneath the horizontal plane through the uppermost wall portion of the hull whereby to so position the storage chamber as will give the least interference with the center of stability and buoyancy of the vessel.

989,065. APPARATUS FOR HANDLING MAGNETIC MATERIALS. JAMES F. SCHNABEL, OF CLEVELAND, O., ASSIGNOR TO THE ELECTRIC CONTROLLER AND MANUFACTURING COMPANY, OF CLEVELAND.

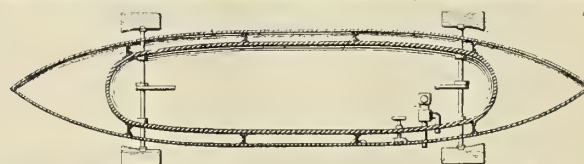
The combination of a lifting magnet, means to raise and lower the same, a receptacle, means to move the receptacle and the magnet into vertical alignment that the magnet may discharge its load into the recep-



tacle, and out of such alignment that the magnet may pass the receptacle, and means for maintaining the receptacle upright, whereby the magnet may deposit more than one load into the receptacle.

989,371. SUBMARINE VESSEL. MAXIME ALFRED LAUBEUF, OF PARIS, FRANCE.

In a submarine vessel, the combination of a hull; and chambers secured to the forward and after ends of the hull, said chambers being of



relatively light and thin material and entirely cut off from all communication with the interior of the hull.